## AFRL-ML-WP-TR-1998-4212

# B-1 AIRCRAFT MAIN HYDRAULIC PUMP TESTS WITH MIL-H-87257 HYDRAULIC FLUID



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In an effort to convert the B-1 aircraft from MIL-H-5606 to the fire resistant MIL-H-87257 hydraulic fluid, the Air	Force					
sponsored a study conducted by Rockwell International from April 1992 through June 1992 under contract						
F34601-89-C-0401. The results of this study are published in Rockwell Report NA-91-1598, date 17 June 1992. A	s part					
of this study, two pump tests were conducted by Vickers using B-1 aircraft hydraulic pumps (Vickers PV3-300-7B)	-					
MIL-H-87257 (ROYCO 777) hydraulic fluid. During the first test, the pump failed prematurely. The second test v						
stopped before the scheduled test duration because some metal was observed in the filter patch test. Due to lack of						
funding, no additional pump tests were carried out to check the compatibility of MIL-H-87257 and the B-1 hydrauli	_					
pumps. This being the only unresolved issue standing in the way of transitioning the MIL-H-87257 fluid to the B-1						
aircraft, the Nonstructural Materials Branch of the Materials and Manufacturing Directorate of Air Force Research						
Laboratory (AFRL/MLBT) undertook in-house pump tests with B-1 hydraulic pumps to provide the necessary data. A						
base line test was conducted using MIL-H-5606 and a second test was run under identical conditions using MIL-H-87257.						
Both pump tests were successful. Based on these tests MIL-H-87257 was deemed suitable for use in B-1 aircraft. The						
results of the pump tests are the subject of this report.						
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### 1.0 INTRODUCTION

MIL-H-83282 is a synthetic, less flammable hydraulic fluid that replaced the flammable MIL-H-5606 hydraulic fluid in most Air Force aircraft. MIL-H-83282 does not meet the viscosity requirements for -65 •F operation. However, MIL-H-87257, the low temperature version of MIL-H-83282 fluid, does meet these requirements.

In an effort to convert the B-1 aircraft from MIL-H-5606 to MIL-H-87257, the Air Force sponsored a study conducted by Rockwell International from April 1991 through June 1992, under contract F34601-89-C-0401. The results of this study are published in Rockwell Report NA-91-1598, dated 17 June 1992. As part of this study, two pump tests were conducted by Vickers using B-1 aircraft hydraulic pumps (Vickers PV3-300-7B) and MIL-H-87257 (ROYCO 777) hydraulic fluid. During the first test, the pump failed prematurely. The second test was stopped before the scheduled test duration because some metal was observed in the filter patch-test. Due to lack of funding no additional pump tests were carried out to check the compatibility of MIL-H-87257 and B-1 hydraulic pumps. This being the only unresolved issue standing in the way of transitioning this fluid to the B-1 aircraft, the Nonstructural Materials Branch of the Materials Directorate of Wright Laboratory (WL/MLBT) decided to conduct in-house pump tests with MIL-H-87257 and B-1 hydraulic pumps to provide the necessary data. The results of the two pump tests carried out at WL/MLBT are the subject of this report.

### 2.0 TEST OBJECTIVE

The objective of this program was to complete the initial studies begun by Rockwell to determine the compatibility of MIL-H-87257 with the B-1 hydraulic pumps.

### 3.0 PUMP TESTS

The Vickers PV3-300-7B hydraulic pump is a constant pressure, variable displacement pump capable of very high flow rates of up to 64 gpm and requiring high horsepower input. Due to the horsepower limitations of the WL/MLBT hydraulic pump test stand, it was not practical to duplicate either the qualifying tests or the tests conducted at Vickers. After reviewing the test conditions and the pump failure modes generated at Vickers during the hydraulic pump testing of MIL-H-87257 hydraulic fluid, the following plan was agreed upon by all the interested organizations.

#### 3.1 PUMP TEST PLAN

Hydraulic Pump: Vickers Model PV3-300-7B Pump (new pump for each test).

Test Fluids: MIL-H-5606F, Baseline, WL/MLBT Pump Test 33

MIL-H-87257 (ROYCO 777), WL/MLBT Pump Test 34

Test Duration: Total 90 hours.

STAGE I: 30 hours

STAGE II: 30 hours

STAGE III: 30 hours

Pump Inlet Pressure: 95-100 psig.

Pump Outlet Pressure: 4150 psig. Pump Outlet Flow: 50 gpm.

Pump Shaft Speed: 5250 rpm.

Pump Inlet Temperature:

STAGE I:

180 °F

STAGE II:

210 °F 250 °F

Filter Elements:

Main Filter - Pall Corporation, P/N AC-9516F-1,

3 micron, replaced after each test

Heat Exchanger Bypass Filter - Pall Corporation

P/N AC-7031F-1297Y6, 5 micron, replaced after each test

Case Drain Filter - Pall Corporation P/N AC-7031F-1297,

5 micron, replaced after each test

Patch Filter - Millipore (housing P/N XX047-00, element P/N LSWP-047-00), 5 micron, inspected and replaced after

each stage

Fluid Samples:

Taken at approximately 0, 6, 15, and 30 hours of each stage

Pump Disassembly and Inspection:

Pretest and after each stage

### 3.2 HYDRAULIC PUMP TEST STAND MODIFICATIONS

The existing pump test stand at WL/MLBT was designed primarily for testing new and experimental hydraulic fluids using small to medium displacement aircraft hydraulic pumps operating at low flow rates. The PV3-300-7B is a large displacement pump, which would be operated at high flow rates during these tests. To accommodate these flow rates, an increase in power, tubing size, filter capacity and heat exchanger capacity was necessary. The modified test circuit is shown in figure 1. The variable speed drive motor on the existing test stand would supply the additional power needed as it would produce 150 hp versus the approximate 145 hp the pump required at the test plan flow rate of 50 gpm. In order to satisfy the other requirements, major changes to the pump test stand were necessary. The hydraulic circuits of the existing test stand were altered in the following manner:

- a. High pressure flow (pump outlet) To accommodate the higher pressure and flow rate from the pump this circuit was rebuilt using larger tubing size. The throttling valve was modified using an upgrade kit. A circuit was also added to bypass this valve. The relief valve was upgraded and recalibrated. The sensors remained unchanged.
- b. Case drain flow What had been the main return hydraulic circuit was modified to serve as the new case drain circuit. The same heat exchanger, filter assembly, flow meter and other sensors were utilized. Several valves and additional sensors were also incorporated into this circuit for temperature-pressure indication and control.
- c. Main return flow (pump inlet) An entirely new circuit was designed and fabricated. Downstream of the throttle valve the new main return flow was split into two similar circuits. The flow through these circuits passed through individual heat exchangers and filters before being rejoined. Also, at this junction the flow from the heat exchanger bypass circuit was added with the combined flow subsequently passing through a new high capacity flow meter. Case drain flow and any needed make-up fluid from the reservoir were then added to the return flow. Further downstream were several sensors and a sampling valve before connection to the pump inlet.

To accomplish these changes and other necessary modifications to the test stand, the following major items were designed, fabricated, purchased or otherwise obtained:

- a. A new pump mounting flange and drive spline were designed and fabricated with the help of necessary installation drawings furnished by Vickers Corporation.
- b. New hydraulic fittings which mate with the pump inlet-outlet and which also use the same spring energized seals as on the aircraft were designed and fabricated. An adapter was purchased for the Rosan fitting on the pump case drain.
  - c. New throttle valve parts were purchased to upgrade this valve.
- d. Two large (3' long x 8" diameter) heat exchangers were purchased. The large size heat exchangers were needed for the 180 °F inlet temperature requirement for Stage I.
- e. Two large capacity filter assemblies including elements were graciously provided by Pall Corporation.
- f. A new high capacity cooling system recirculating pump, associated fittings and hoses were purchased. Modification to the cooling systems reservoir was also made to accommodate this new pump.

After all these changes were accomplished, the test stand required approximately 8 gallons of test fluid to fill, the majority of it being in the heat exchangers and filters. During operation, approximately 7 gallons of fluid circulated. A schematic of the entire B-1 hydraulic pump test circuit is shown in Figure 2.

### 3.3 PUMP TESTS

The WL/MLBT hydraulic pump test stand is computer controlled with automatic shutdown interlocks. Data obtained during testing is presented digitally and simultaneously recorded on strip charts.

During these tests, pump stand start up was accomplished in the following manner. After proper pump test stand preparation, the pump depressurizing circuit was energized which allowed the drive motor and the pump speed to be increased at lower pump outlet pressures. After a few seconds and at around 5000 rpm, this circuit was de-energized allowing the outlet pressure to increase to normal levels. The speed was then increased to 5250 rpm, followed by a gradual increase of the output flow from the startup value of 3 gpm to 50 gpm. The pump inlet temperature was maintained at the desired value and the test continued for the entire 30 hour stage duration.

### 3.3.1 PUMP TESTS 33 AND 34

The MIL-H-5606F testing was conducted as outlined in Section II except that the pretest pump disassembly and inspection before the start of Stage I was not conducted. This pump was installed on the test stand in order to verify proper operation of the modified test stand. During this verification process, and filling the stand with fresh MIL-H-5606F, approximately 12 operating hours were accumulated on the pump, of which very few were at high flow rates or at high fluid temperature. It was then decided to continue using this pump for Test 33 without removing it from the stand for pretest inspection. During inspection after Stage I completion, a slight anomaly was observed on the rubbing surfaces of the piston shoes - radial erosion lines across the shoe faces. Unfortunately, since there was no pump inspection before the beginning of Stage I there is no way to determine if these lines were generated during pump stand operation verification, Stage I testing or were there to begin with. This condition did not seem to affect the performance of the pump. The subsequent pump inspections after Stage II and III revealed little or no change in the appearance of these lines. With the exception of these radial lines, the disassembly and inspection of the pump after each stage completion showed only slight polishing wear with no signs

of loose material or debris. No evidence of cavitation on any pump parts was observed. Overall, the pump and the test fluid performed well during this test. No adjustments were made to the pump compensator before or during this test. Inspection of the patch filter after each stage completion revealed nothing unusual. No significant leaks were observed from the test stand. A total of about 500 ml of fluid leaked from the pump shaft seal. After completion of this test the great majority of the fluid was drained from the tubing, filter assemblies, reservoir and heat exchangers. Some of the tubing, the filter bowls and both large heat exchangers were removed from the stand and drained. The heat exchangers were partially disassembled to facilitate the draining process.

Pump Test 34 with MIL-H-87257 fluid was also conducted as outlined in Section II. Again, the pump and test fluid performed well. There were no discrepancies observed during pump inspections which were conducted after the completion of each stage. There were no signs of any loose material or debris, and only some slight polishing wear was observed on most rubbing surfaces. No evidence of cavitation on any pump part was observed. No adjustments were made to the pump compensator before or during this test. Inspection of the patch filter revealed nothing unusual. No significant leaks were observed from the test stand. A total of 115 ml of fluid leaked from the pump shaft seal.

Photographs of all critical pump parts and surfaces were taken during the pump inspections. These photos are presented in Appendix A and B. Detailed video movies were made during each disassembly and inspection, and are available for loan from WL/MLBT (point of contact: Shashi K. Sharma, at (937) 255-9029).

The pump case drain flow rates were observed and recorded during both pump tests. A comparison plot of the data is shown in Figure 3. It is interesting to note the case drain flow rates for the MIL-H-5606F fluid start out lower, but end up at a higher rate when compared to the flow rates for MIL-H-87257 fluid. This is attributed to the loss of viscosity of MIL-H-5606 with time due to its shear instability, discussed later.

The bleeding of air from the test stand was more difficult in the case of MIL-H-5606 as it seemed to retain more air than MIL-H-87257.

### 3.4 ANALYSIS OF FLUID SAMPLES

During the pump tests, fluid samples were extracted from the operating test stand as the testing progressed. These samples were taken at the approximate intervals listed in Section II. A number of different analyses were conducted on these samples.

The viscosities of the fluid samples taken were determined at 40 °C and 100 °C. These viscosities are compared in Figure 4. It is easily seen that MIL-H-5606F suffered significant viscosity losses during the first 30 hours of pump testing, whereas the viscosity of MIL-H-87257 was very stable throughout the test. The viscosity index (VI) improvers used to boost the viscosity of MIL-H-5606, break-up under the high shear environment inside the pump, causing a permanent loss of the fluid viscosity. Under the high pressure and high shear rate environment, the VI improved fluids behave more like the base oil (Reference 1).

Water content and acid numbers of the fluid samples were determined and are shown in Table 1.

Trace metal analysis was also performed on these fluid samples. The samples were analyzed for 19 elements including Fe, Ag, Cr, Cu, Mg, Na, Ni, Pb, Si, Sn, Ti, B, Ba, Cd, Mn, Mo, V, and Z. Only those elements which show concentrations above 0.1 ppm. are reported in Table 2.

Samples taken at the end of each stage of testing and the fresh samples of each of the test fluids were evaluated for lubricity. These evaluations were accomplished by 4-ball wear testing method (ASTM D-

4172). The results of the lubricity tests are shown in Figure 5. Clearly, these data indicate better lubricity for MIL-H-87257 when compared to MIL-H-5606F.

#### 4.0 CONCLUSIONS

- 4.1 MIL-H-5606 and MIL-H-87257 hydraulic fluids were successfully pump tested in B-1 aircraft hydraulic pumps under identical conditions. Both pumps showed only slight polishing wear with the exception of the appearance of radial lines on the piston shoe faces of the pump tested with MIL-H-5606. It could not be concluded whether these lines appeared during the testing, or existed prior to the test. However, these lines did not seem to affect the functioning of the pump, and also did not grow in size during the test. No cavitation on any pump parts was observed for both tests.
- 4.2 MIL-H-87257 exhibited better lubricity than MIL-H-5606, as determined by the ASTM D-4172 four-ball wear tests.
- 4.3 Viscosity of MIL-H-5606 reduced by 50% during the first 30 hours of testing.
- 4.4 MIL-H-5606 seems to retain more air than MIL-H-87257.
- 4.5 MIL-H-87257 has exhibited equivalent or better performance than MIL-H-5606 in the B-1 hydraulic pump tests.

#### 5.0 REFERENCES

1. Sharma, S.K. and Forster, N.H., and Gschwender, L.J., "Effect of Viscosity Index Improvers on the Elastohydrodynamic Lubrication Characteristics of a Chlorotrifluoroethylene and a Polyalphaolefin Fluid," Tribology Transactions, vol. 36, no. 3, pp 555-564, Oct 1993

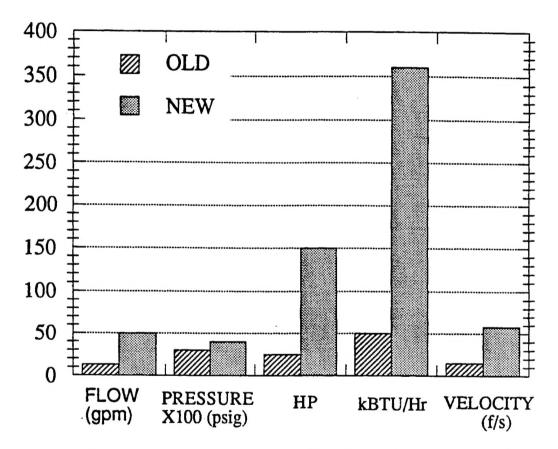
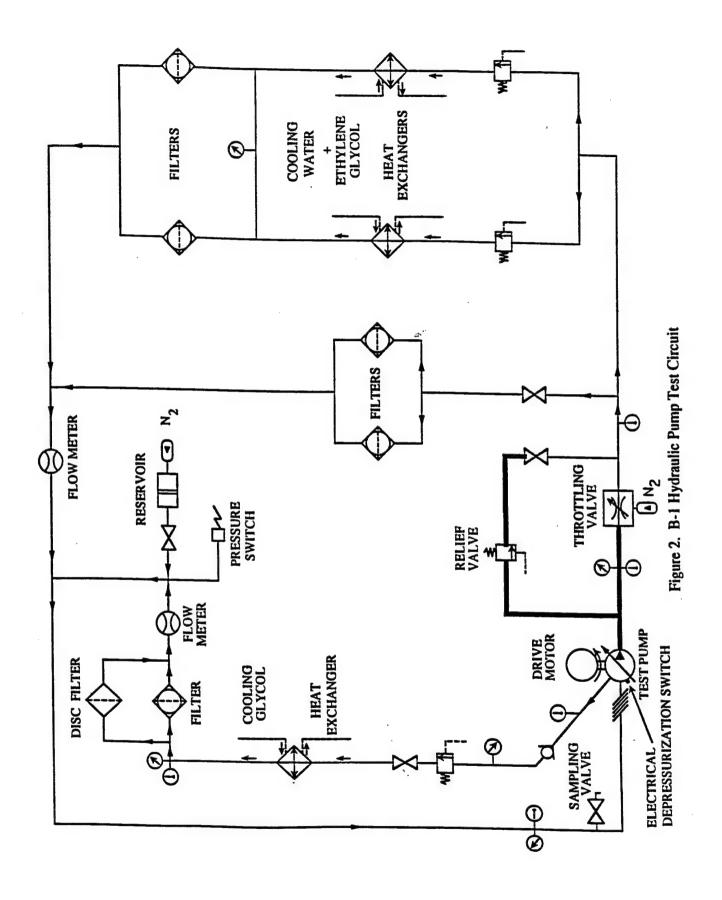


Figure 1. Hydraulic Pump Test Stand Configurations



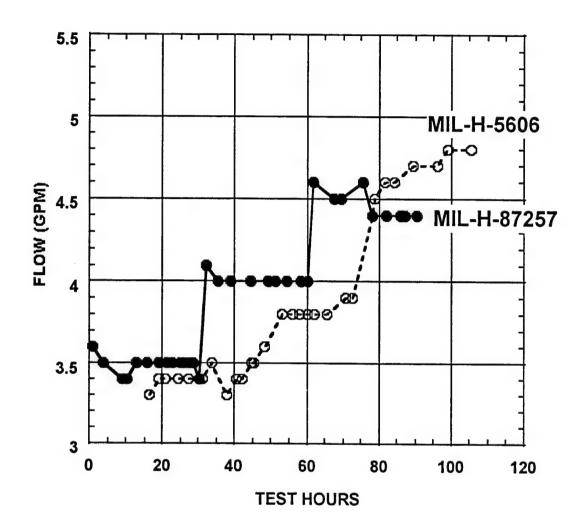


Figure 3. Case drain flow in B-1 pump tests

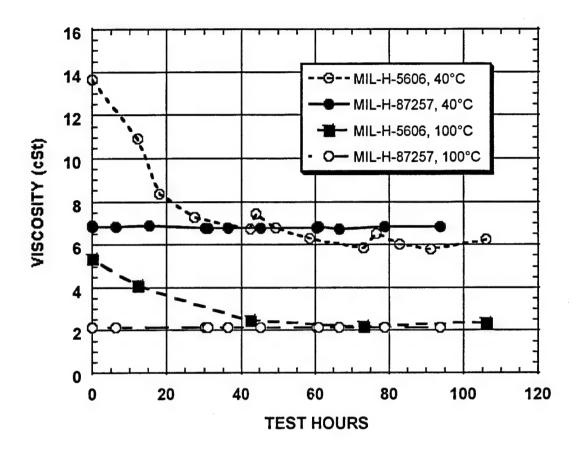


Figure 4. Viscosity change in B-1 pump tests

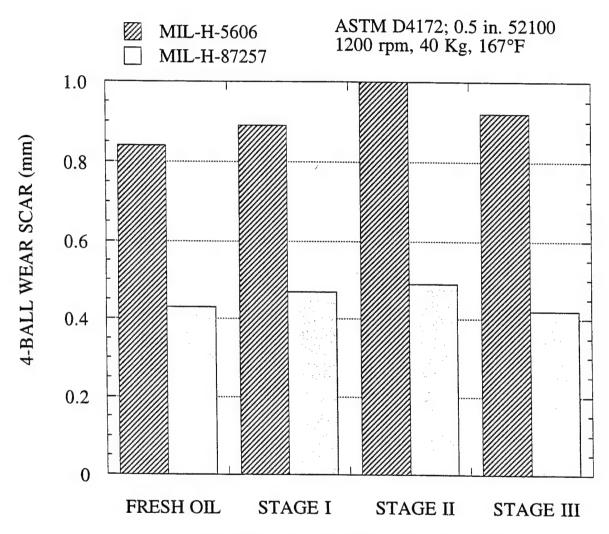


Figure 5. Four-Ball Wear Scar with B-1 Pump Test Fluid Samples

### 7.0 TABLES

TABLE 1. WATER CONTENT AND ACID NUMBERS OF MIL-H-5606F

SAMPLE NUMBER	TOTAL HOURS	STAGE HOURS	WATER (ppm)	ACID NO. (mgKOH/gm)
STAGE-I				. 0 0 ,
FRESH FLUID	0.0	0.0	56	0.00
MLO 93-1	12.2	0.2	55	0.00
MLO 93-2	18.0	6.0	57	•
MLO 93-3	27.5	15.5	•	•
MLO 93-4	42.5	30.0	94	0.00
STAGE-II				
MLO 93-5	44.2	1.0	89	0.00
MLO 93-6	49.5	6.3	•	•
MLO 93-7	58.3	15.1	•	•
MLO 93-8	73.2	30.0	116	0.08
STAGE-III				
MLO 93-9	76.6	0.2	92	0.00
MLO 93-10	82.7	6.0	•	•
MLO 93-11	91.4	15.0	•	*
MLO 93-12	106.0	29.6	90	0.00
MLO 93-13 (case line)	106.0	29.6	116	0.00
MLO 93-14 (pump case)	106.0	29.6	97	•

<sup>\*</sup> data not determined

### WATER CONTENT AND ACID NUMBERS OF MIL-H-87257

SAMPLE NUMBE	ER	TOTAL HOURS	STAGE HOURS	WATER (ppm)	ACID NO. (mgKOH/gm)
STAGE-I					
FRESH FLU	JID	0.0	0.0	85	0.04
MLO 93-66	6	0.1	0.1 . ^	127	0.00
MLO 93-15	5	6.1	6.1	172	•
MLO 93-16	6	15.3	15.3	169	•
MLO 93-6	7	30.3	30.3	168	•
STAGE-II					
MLO 93-68	8	30.8	0.5	166	0.00
MLO 93-69	9	36.3	6.0	•	*
MLO 93-7	0	45.4	15.1	•	•
MLO 93-7	1	60.3	30.0	173	0.00
STAGE-III					
MLO 93-73	2	60.9	0.6	165	0.00
MLO 93-7	3	66.7	6.0	*	•
MLO 93-7	4	78.8	15.0	*	•
MLO 93-7		93.8	30.0	154	0.00

<sup>\*</sup> data not determined

Table 2. Trace Metal Analysis of Pump Test Fluid Samples

Test 33 with MIL-H-5606F

Sample Number	Total Hours	Stage Hours	Fe (ppm)	Ba (ppm)
Stage I				
MLO 93-1	12.2	0.2	0.00	1.7
MLO 93-2	18.0	6.0	0.12	1.9
MLO 93-3	27.5	15.5	0.16	1.9
MLO 93-4	42.5	30.0	0.26	2.0
Stage II				
MLO 93-5	44.2	1.0	0.22	1.5
MLO 93-6	49.5	6.3	0.26	1.7
MLO 93-7	58.3	15.1	0.31	1.8
MLO 93-8	73.2	30.0	0.39	1.8
Stage III				
MLO 93-9	76.6	0.2	0.27	1.5
MLO 93-10	82.7	6.0	0.32	1.5
MLO 93-11	91.4	15.0	0.33	1.6
MLO 93-12	106.0	29.6	0.35	1.5
MLO 93-13 (case line)	106.0	29.6	0.41	1.5
MLO 93-14 (pump case)	106.0	29.6	0.49	1.6

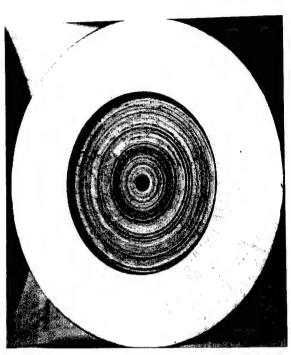
Test 34 with MIL-H-87257

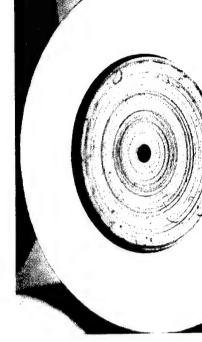
Sample Number	Total Hours	Stage Hours	Fe (ppm)	Ba (ppm)
Stage I				
MLO 93-66	0.1	0.1	0.13	3.1
MLO 93-15	6.1	6.1	0.02	2.4
MLO 93-16	15.3	15.3	0.04	2.3
MLO 93-67	30.3	30.3	0.05	2.3
Stage II				
MLO 93-68	30.8	0.5	0.04	2.3
MLO 93-69	36.3	6.0	0.05	2.2
MLO 93-70	45.4	15.1	0.05	2.2
MLO 93-71	60.3	30.0	0.06	2.1
Stage III				
MLO 93-72	60.9	0.6	0.07	2.1
MLO 93-73	66.7	6.0	0.07	1.9
MLO 93-74	78.8	15.0	0.06	1.9
MLO 93-75	93.8	30.0	0.08	1.6

Appendix A

Inspection Photographs from

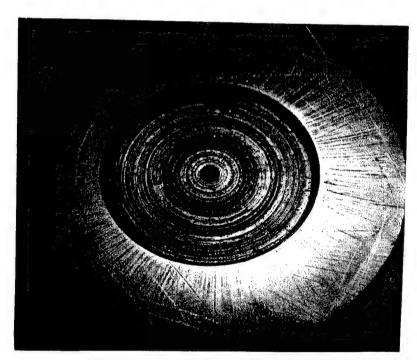
Pump Test 33, MIL-H-5606F





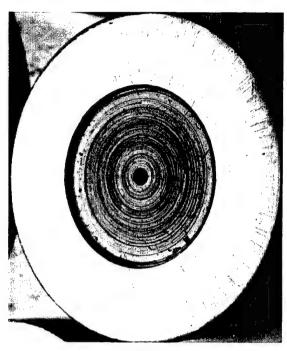
Stage I

Stage II

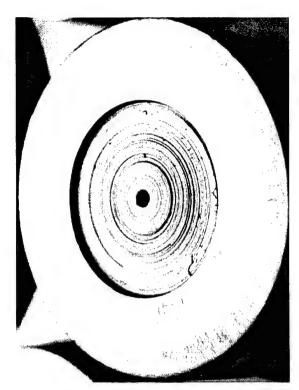


Stage III

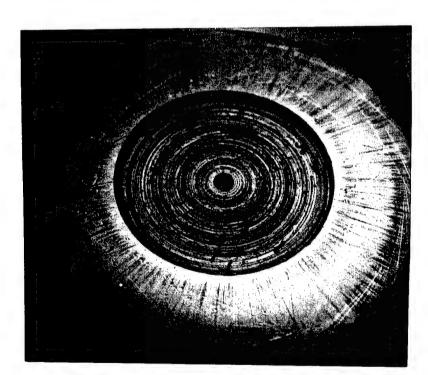
Piston 1 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F



Stage I

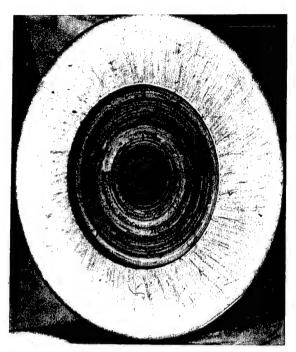


Stage II

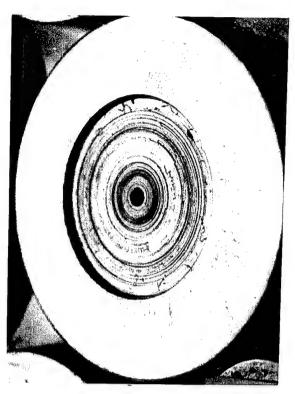


Stage III

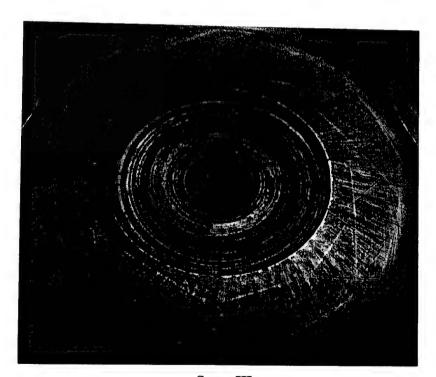
Piston 2 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F



Stage I

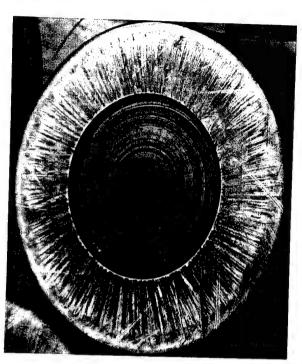


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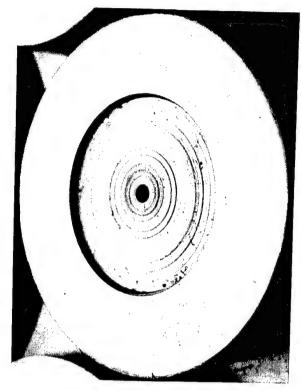


Stage III

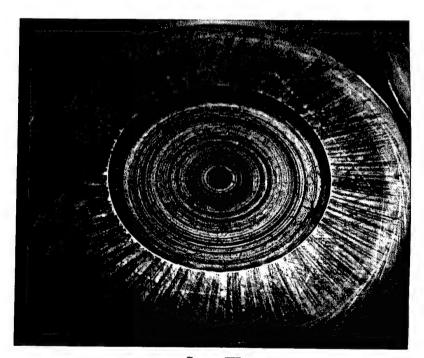
Piston 3 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





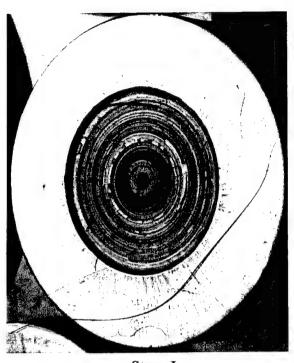


Stage II

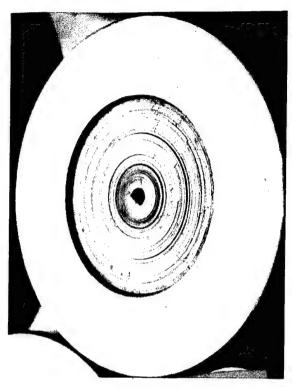


Stage III

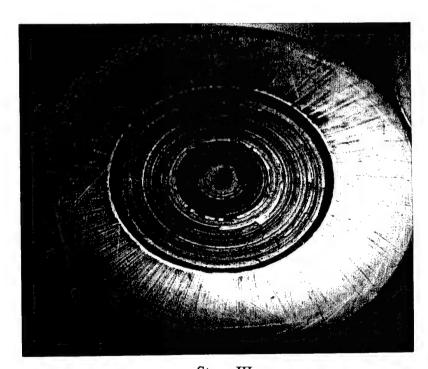
Piston 4 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





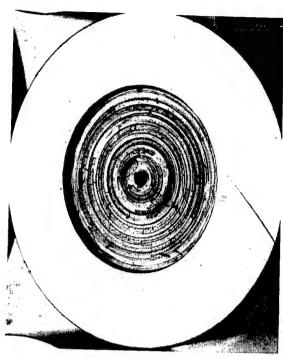


Stage II



Stage III

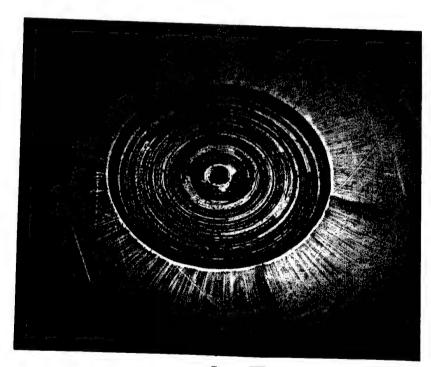
Piston 5 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F



Stage I

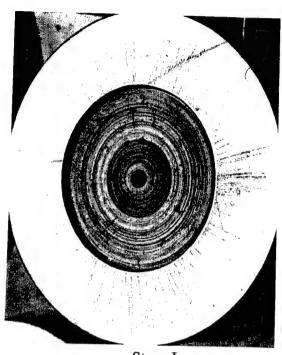


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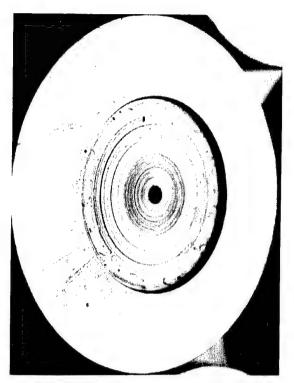


Stage III

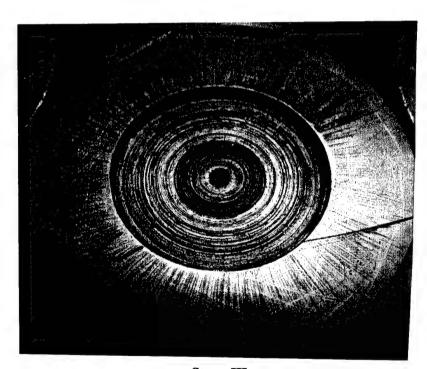
Piston 6 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





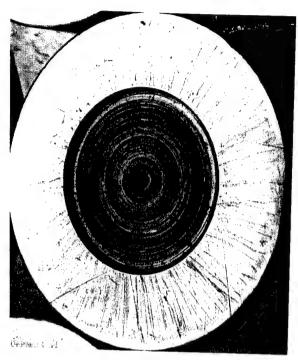


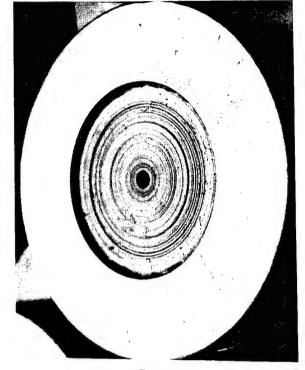
Stage II



Stage III

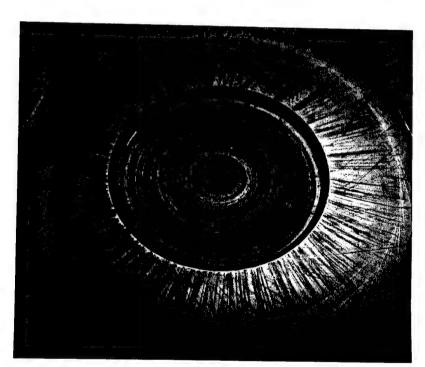
Piston 7 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





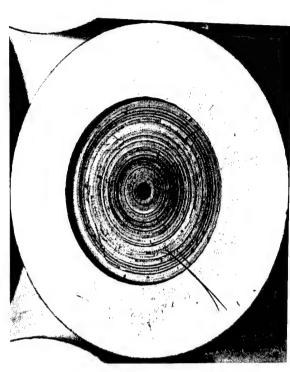
Stage I

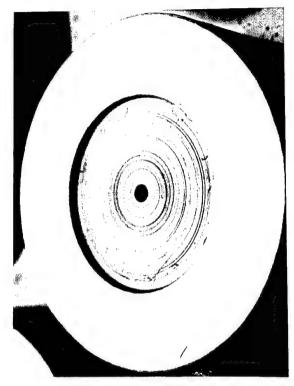
Stage II



Stage III

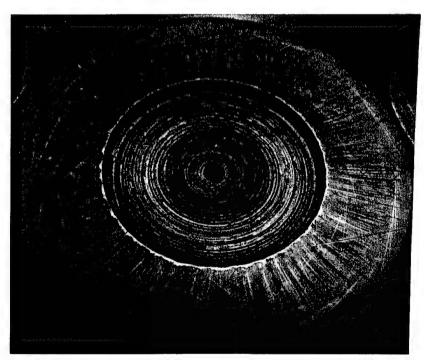
Piston 8 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





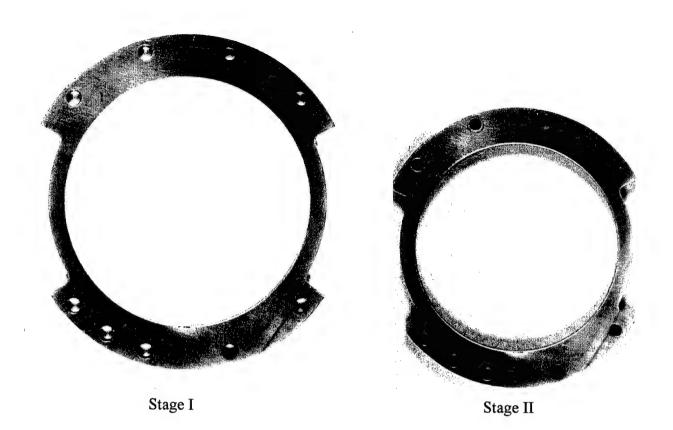
Stage I

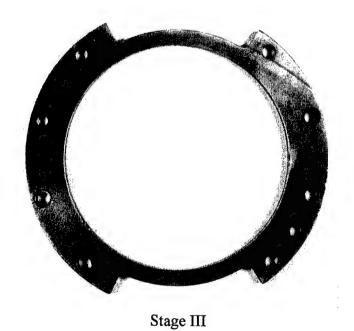
Stage II



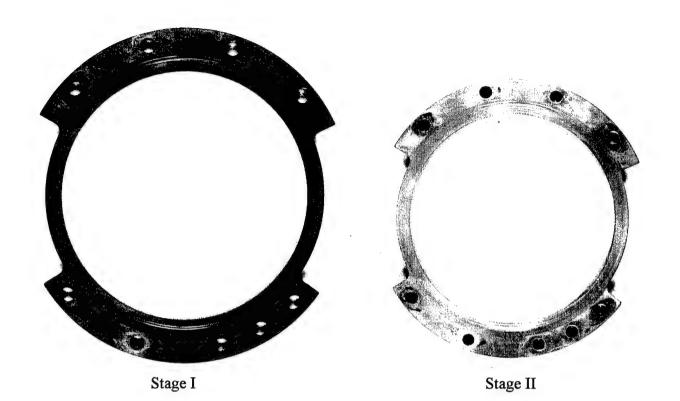
Stage III

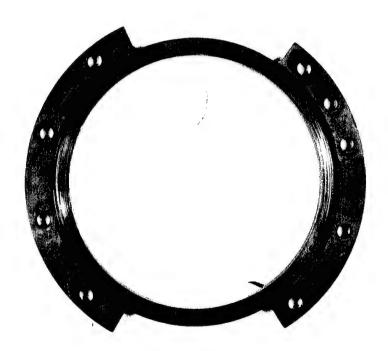
Piston 9 Shoe Face After Stages I, II, and III Pump Test 33 with MIL-H-5606F





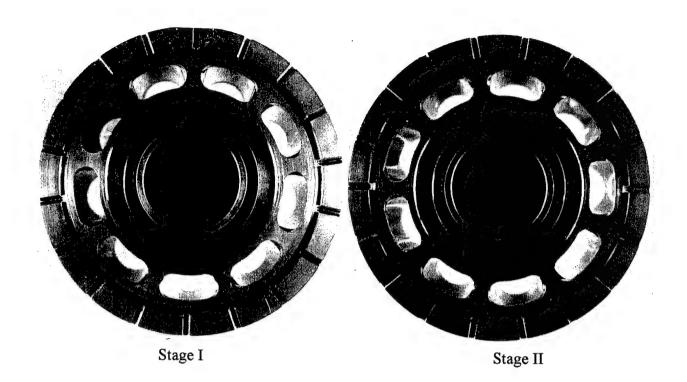
Hold Down Plate - Non Rubbing Side after Stage I, II and III Pump Test 33 with MIL-H-5606F

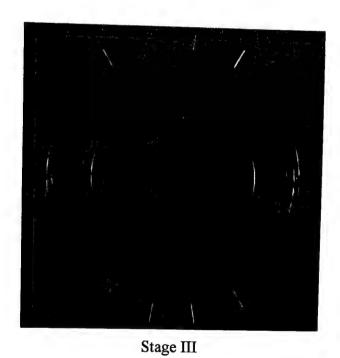




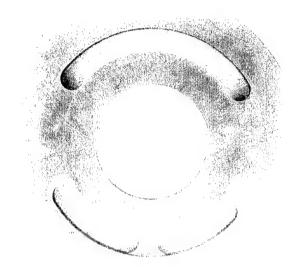
Stage III

Hold Down Plate - Rubbing Side after Stage I, II and III Pump Test 33 with MIL-H-5606F





Cylinder Block Face after Stage I, II and III Pump Test 33 with MIL-H-5606F

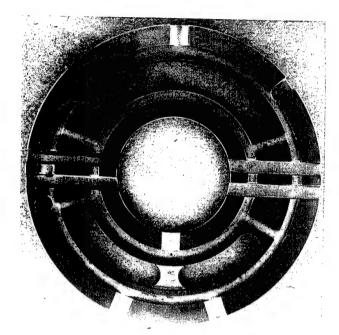


Stage II

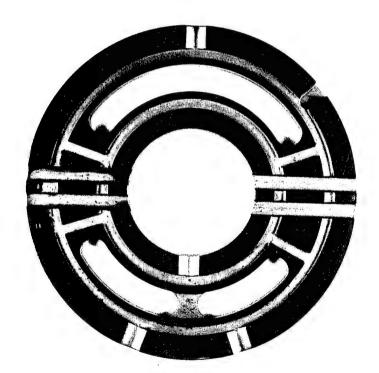


Stage III

Waffle Plate - Rubbing Side after Stage II and III Pump Test 33 with MIL-H-5606F



Stage II



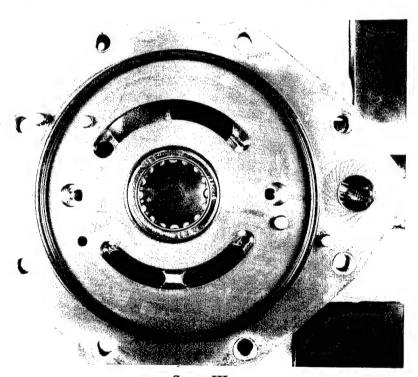
Stage III

Waffle Plate - Non Rubbing Side after Stage II and III Pump Test 33 with MIL-H-5606F



Stage I

Stage II



Stage III

Cylinder Block Plate after Stage I, II and III Pump Test 33 with MIL-H-5606F



Stage I

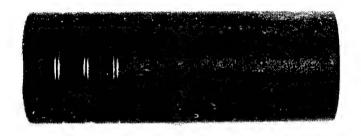


Stage II

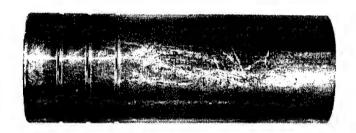


Stage III

Actuator Piston - Front View after Stage I, II and III Pump Test 33 with MIL-H-5606F

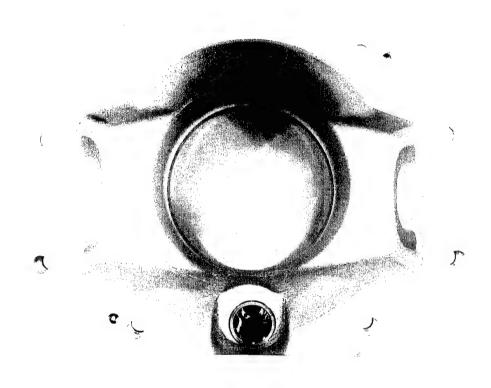


Stage II

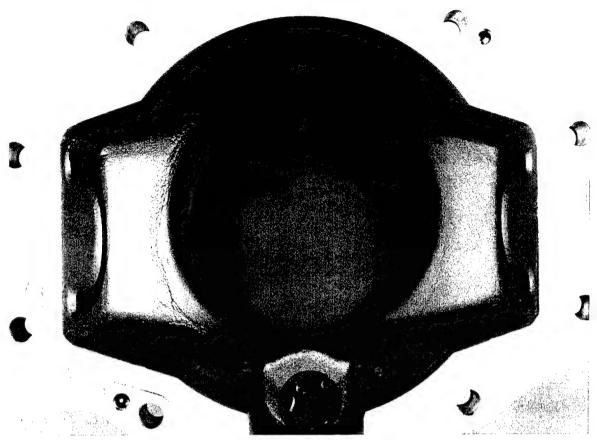


Stage III

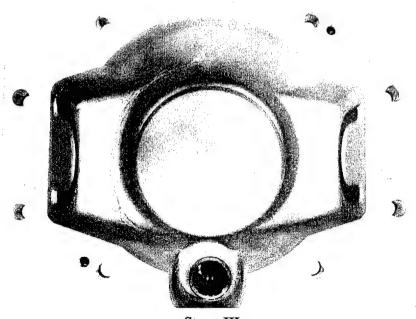
Actuator Piston -Side view after Stage II and III Pump Test 33 with MIL-H-5606F



Housing after Stage I Pump Test 33 with MIL-H-5606F

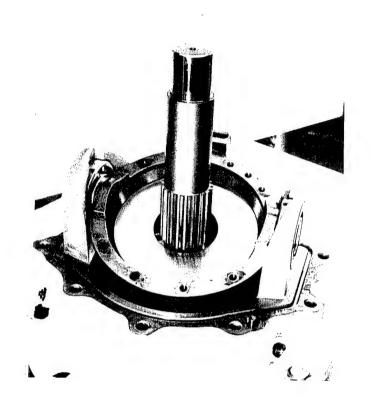


Stage II



Stage III

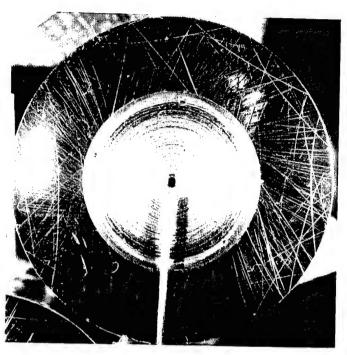
Housing after Stage II and III Pump Test 33 with MIL-H-5606F



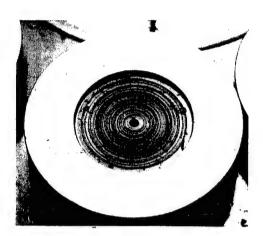
Partial Assembly of Test Pump after Stage II Pump Test 33 with MIL-H-5606F Appendix B

Inspection Photographs from

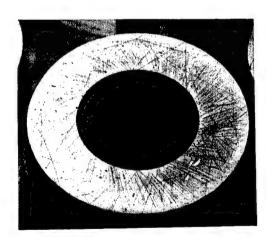
Pump Test 34, MIL-H-87257



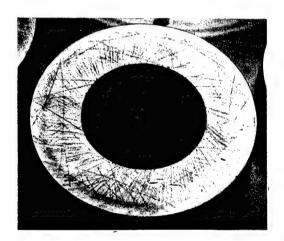
Pretest



Stage I

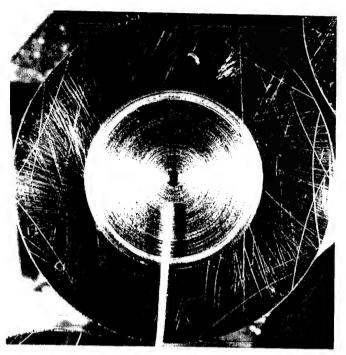


Stage II



Stage III

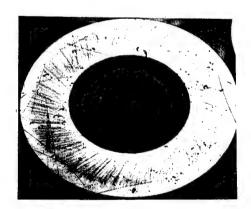
Piston 1 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



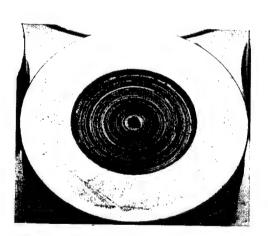
Pretest



Stage I



Stage II

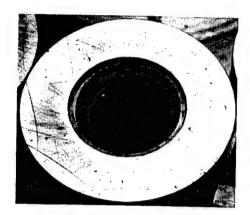


Stage III

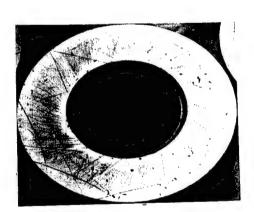
Piston 2 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



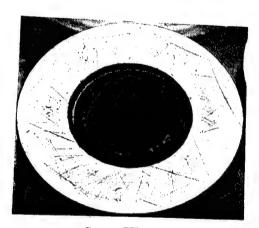
Pretest



Stage I



Stage II

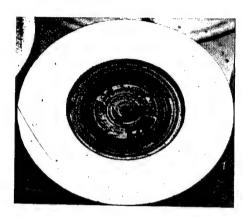


Stage III

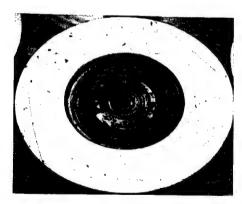
Piston 3 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I

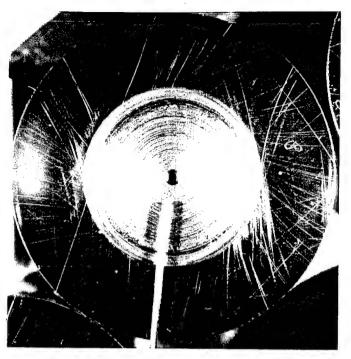


Stage II

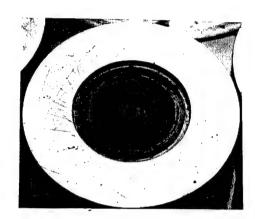


Stage III

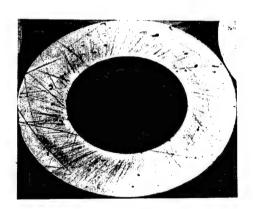
Piston 4 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I



Stage II

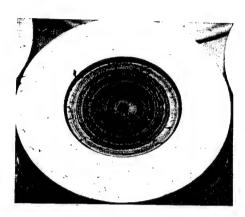


Stage III

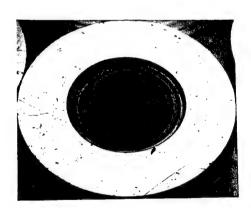
Piston 5 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



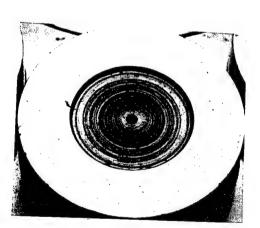
Pretest



Stage I



Stage II



Stage III

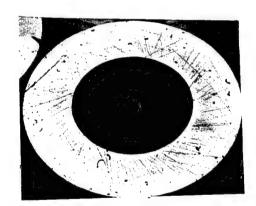
Piston 6 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I



Stage II



Stage III

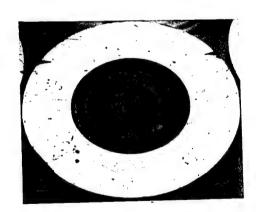
Piston 7 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I



Stage II

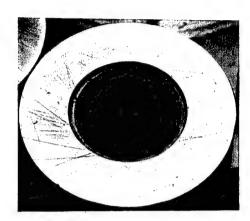


Stage III

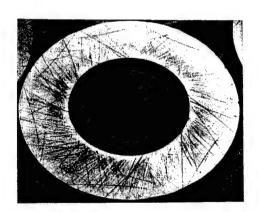
Piston 8 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I

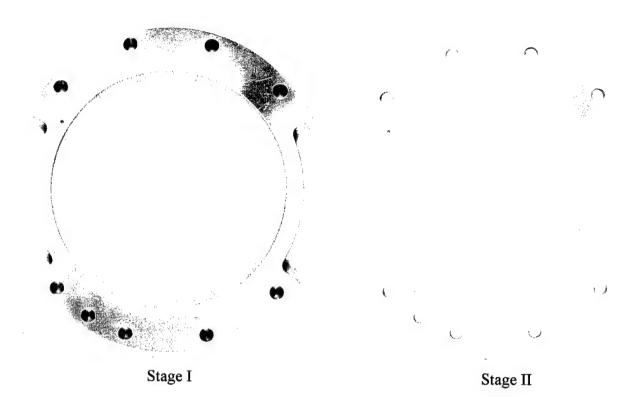


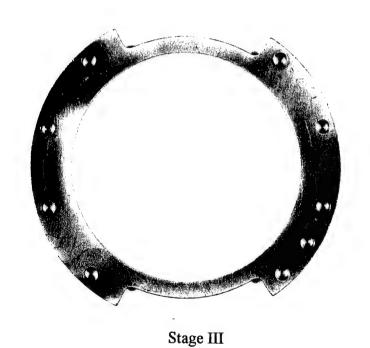
Stage II



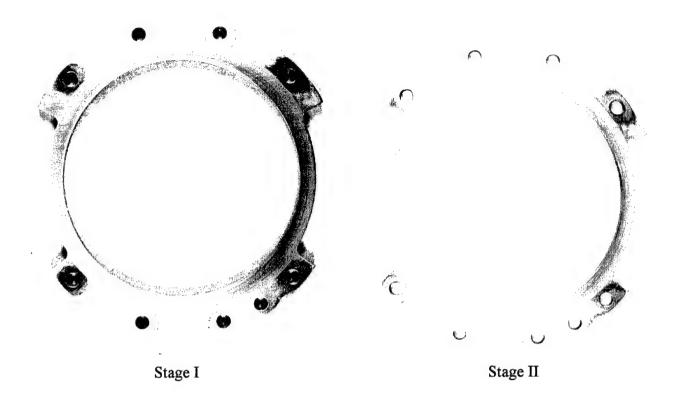
Stage III

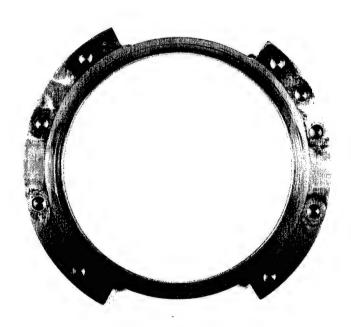
Piston 9 Shoe Face at Pretest, and After Stages I, II, and III
Pump Test 34 with MIL-H-87257





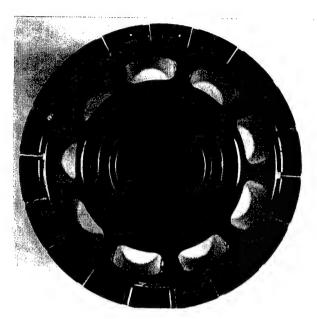
Hold Down Plate - Non Rubbing Side after Stage I, II, and III Pump Test 34 with MIL-H-87257



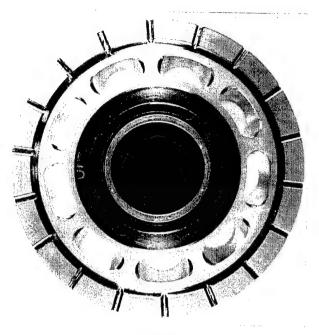


Stage III

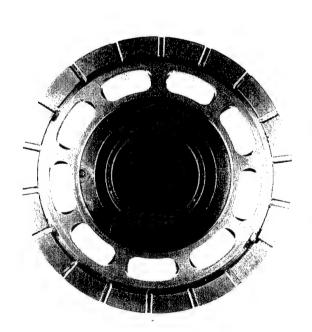
Hold Down Plate - Rubbing Side after Stage I, II, and III Pump Test 34 with MIL-H-87257



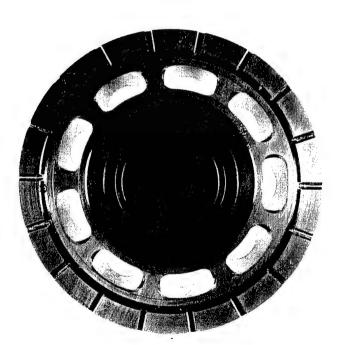
Pretest



Stage I

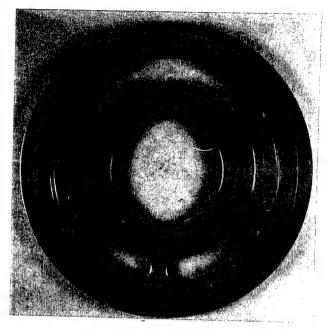


Stage II

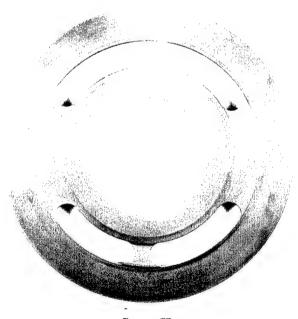


Stage III

Cylinder Block Face at Pretest and after Stage I, II, and III Pump Test 34 with MIL-H-87257

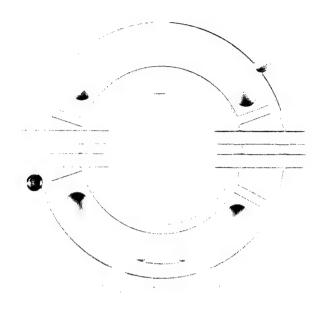


Stage I

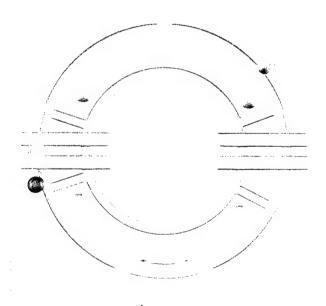


Stage II

Waffle Plate - Rubbing Side after Stage I and II Pump Test 34 with MIL-H-87257

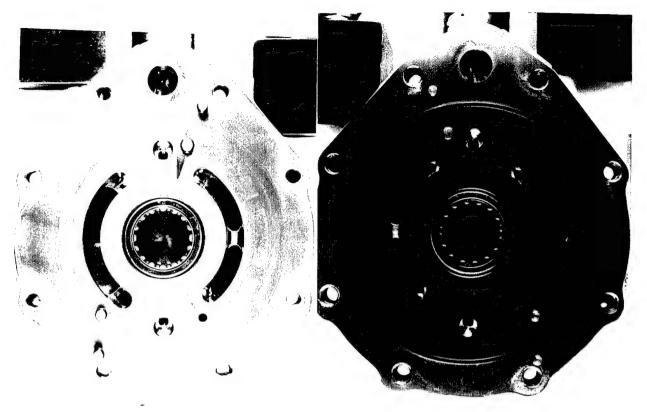


Stage I

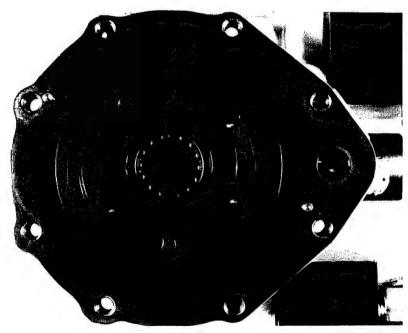


Stage II

Waffle Plate - Non Rubbing Side after Stage I and II Pump Test 34 with MIL-H-87257



Stage I Stage II

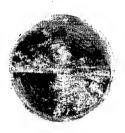


Stage III

Cylinder Block Plate after Stage I, II, and III Pump Test 34 with MIL-H-87257



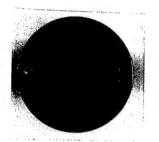
Pretest



Stage I

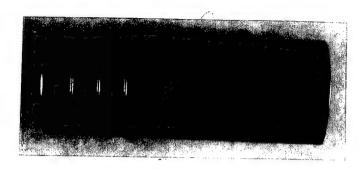


Stage II



Stage III

Actuator Piston - Front View at Pretest and after Stage I, II, and III
Pump Test 34 with MIL-H-87257



Pretest



Stage I



Stage II



Stage III

Actuator Piston - Side View at Pretest and after Stage I, II, and III Pump Test 34 with MIL-H-87257

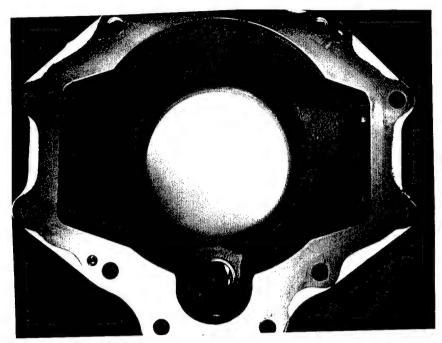


Pretest

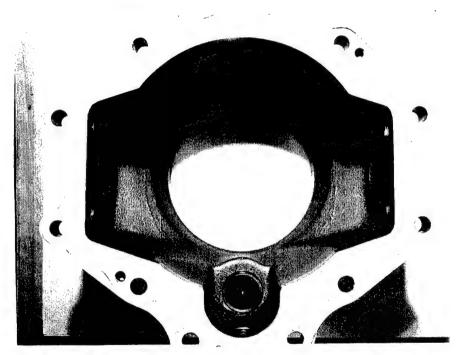


Stage I

Housing at Pretest and after Stage I Pump Test 34 with MIL-H-87257

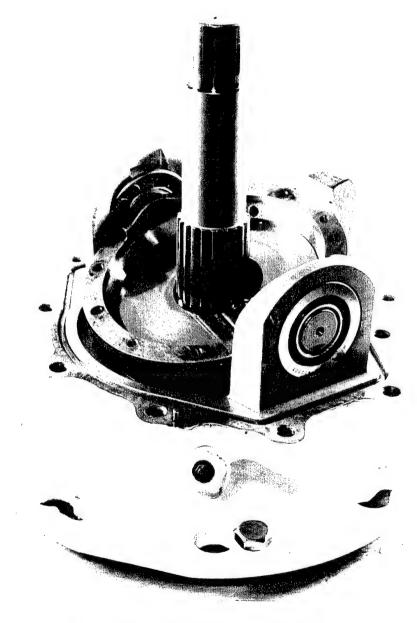


Stage II



Stage III

Housing after Stage II and III Pump Test 34 with MIL-H-87257



Partial Assembly of Test Pump at Pretest Pump Test 34 with MIL-H-87257

Appendix C

Raw Data for Pump Test 33

with MIL-H-5606F

TEST PUMP : MODEL VICKORS PV3-300-7B S/N : MX 490659B

PUMP TEST DATA FOR A RCRAFT HYDRAULIC FLUID WLMLBT, WPAFB PUMP TEST STAND NO. 1

Mil-H-5606F MLO 92-144

TEST FLUID:

Test Total Flow Seal Calions) Heav. Seal Calions	D Thropling Valve Close	No Close	5							1		-			Day on Out	Mad/ com		q	Prime folat	Pump Outlet
Cell         Test         (Gallons)         Heave         Counter           (F)         (as on the Main         Case         Disc         Leviel         (min)           65         12.2         0         0         0         0         0           65         14.7         0         0         0         0         0         0           65         14.7         0         0         0         0         0         0         0           65         14.7         0	Sillion F	Test	1		Total Flow	4		Total	Speed	p =	lorque (in-lbf)	_ ฉี	Current	Main	Cas	Case Filter	Case		Pressure	Pressure
Tomp. Hrs. (F) (as on the counter)         Main         Case         Disc. Level (mm)           65         12.2         0         0         0           12.2         0         0         0         0           12.2         12.2         0         0         0           12.2         12.2         0         0         0           14.7         0         0         0         0           65         14.7         0         0         0           77         16.3         10,808         7.06         131.56           77         16.3         10,808         7.06         131.56           77         16.3         10,808         7.06         131.56           77         24.3         24,745         2,896         131.40           72         31.2         25,429         3,736         131.40           72         32.6         4,745         2,896         131.40           72         33.9         63,681         4,296         131.40           72         33.0         63,681         4,296         131.40           80         40.5         83,287         5,006         131.40		င်္ခ			(Gallons)		7057	le de la contraction de la con		-		(8)	(amps)	Filter 1		Pall Corp.	Filter	-	(psig)	(psig)
65 12.0 0 0 0 12.2 12.2 12.2 12.2 12.2 12.				Main	Case	Disc	Level (mm)	(ml)	4	8	<	<b>8</b>	8	. v	4	Deg. C	: <	8	В	<
65         14.7           65         14.7           65         14.9           77         16.3           16.0         10.808         706           77         16.3         10,808         706           80         18.0         18.853         1,244         131.56           72         21.0         24.856         1,646         131.56           71         24.3         34.745         2,996         131.56           69         27.5         44,745         2,996         131.40           73         31.2         55,429         37.36         131.40           73         31.2         55,429         37.36         131.40           72         39.0         75,658         5,106         131.40           72         39.0         75,658         5,106         131.40           80         40.5         83.287         5,620         131.40           80         40.5         89.034         6,012         250           80         40.5         89.034         6,012         250           82         44.2         89.034         6,564         131.30           82		9		0	0				1			1	1	+	-					
65         14.7           65         14.7           65         14.9           77         16.3         10,808         706           80         18.0         18.953         1,244         131.56           72         21.0         24.956         1,646         131.56           71         24.3         34.914         2,322         131.56           71         24.3         34.914         2,322         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         38.0         75,659         5,106         131.40           73         38.0         75,659         5,106         131.40           80         40.5         83,287         5,620         131.40           42.5         89,034         6,012         250           44.2         44.2         80,034         6,012         250           82         44.7	5-Jan-93 0917		12.2						+	1	+	+		+		-				
65         14.7           65         14.9           65         14.9           77         16.3         10,808         706           80         18.0         18.853         1,244         131.56           72         24.3         34.814         2,322         131.56           71         24.3         34.745         2,996         131.40           73         31.2         55,429         37.36         131.40           73         31.2         55,429         37.36         131.40           72         33.9         63,681         4,296         131.40           72         33.9         63,681         4,296         131.40           72         33.9         63,681         4,296         131.40           72         33.0         75,658         5,106         131.40           72         33.0         42.6         6,012         131.37           80         40.5         89,034         6,012         250           82         44.2         89,034         6,564         131.30         350           82         44.7         94,746         6,406         131.30         30	5-Jan-93 1147	7	14.7						+	1		+								
65         14.9         706           77         16.3         10,808         706           80         19.0         18.953         1,244         131.56           72         21.0         24.956         1,646         131.56           71         24.3         34.745         2,926         131.40           73         31.2         55,429         3736         131.40           73         31.2         55,429         3736         131.40           73         31.2         55,429         3736         131.40           72         33.9         63,681         4,296         131.40           72         33.0         75,658         5,106         131.40           72         33.0         75,658         5,106         131.40           80         40.5         83.287         5,620         131.37           80         40.5         89,034         6,012         250           82         44.2         80,034         6,012         270           82         44.7         94,746         6,012         131.30         320           82         44.7         94,746         6,644         131.30	7-Jan-93 0835								1					+	-					
77         16.3         10,808         706           80         18.0         1244         131.56           60         19.0         18.953         1,244         131.56           72         21.0         24.956         1,646         131.56           71         24.3         34.14         2,322         131.56           69         27.5         44,745         2,996         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         30.0         75,658         5,106         131.40           72         32.6         5,808         131.40           80         40.5         87,500         5,808         131.40           42.4         47.2         87,500         5,808         131.37           44.2         44.2         44.2         6,912         250           82         44.7         94,746         6,640         131.30         350           82         45.5         97,037         6,564         131.30 <td>7-Jan-93 0850</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>300</td> <td></td> <td>1750</td> <td>164</td> <td></td> <td>26</td> <td></td> <td></td> <td>4</td> <td>6</td> <td>9.2</td> <td>4,136</td>	7-Jan-93 0850								300		1750	164		26			4	6	9.2	4,136
80         18.0         18.0         18.953         1,244         131.56           72         21.0         24.956         1,244         131.56           71         24.3         34.914         2,322         131.56           69         27.5         44,745         2,996         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           73         31.2         55,429         3,736         131.40           72         33.9         63,681         4,296         131.40           72         38.0         75,658         5,106         131.40           72         38.0         75,658         5,106         131.40           80         40.5         83.287         5,620         131.40           42.6         87,500         5,908         131.37         250           80         44.2         44.2         6,012         250           82         44.7         84,746         6,012         270           82         44.7         84,746         6,564         131.30           83         43.5 <td>7-Jan-93 1025</td> <td></td> <td></td> <td>10,808</td> <td>706</td> <td></td> <td>+</td> <td></td> <td>2,220</td> <td></td> <td>7671</td> <td>2</td> <td></td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	7-Jan-93 1025			10,808	706		+		2,220		7671	2		-						
60         19.0         18,853         1,244         131.56           72         21.0         24,856         1,646         131.56           71         24.3         34,814         2,322         131.56           69         27.5         44,745         2,996         131.40           73         31.2         55,429         3,736         131.40           73         36.6         6         131.40           73         36.6         6         131.40           79         38.0         75,659         5,620         131.40           80         40.5         83,287         5,620         131.40           42.6         87,500         5,808         131.40           42.7         87,500         5,808         131.37           80         44.2         80,034         6,012         250           82         44.7         84,746         6,406         131.50         270           82         45.5         97,037         6,564         131.30         320           83         46.5         97,037         6,564         131.30         320           84         45.5         97,037         6,564									000		1750	163	-	26	3.6	7.1	2	6	93	4,137
72 21.0 24,956 1,646 131,56 69 27.5 44,745 2,996 131.40 69 27.5 44,745 2,996 131.40 73 31.2 55,429 3,736 131.40 72 38.6 5.106 131.40 80 40.5 83,287 5,620 131.30 80 44.2 6,908 131.50 270 81 44.2 6,50 5,908 131.50 270 82 44.7 94,746 6,406 131.50 320 83 53,1 119,760 8,224 131.30 350 84 55,1 128,843 8,892 131.30 350 85 55,1 128,843 8,892 131.30 350 86 57.9 134,120 9,292 131.30 360				18,953	1,244		131.56		3,220		4750	163		25	3.5	5 68		6	94	4,137
71         24.3         34,814         2,322         131.56           69         27.5         44,745         2,896         131.30           69         27.5         31.2         55,429         3,736         131.40           72         33.9         63,681         4,296         131.40           72         33.9         63,681         4,296         131.40           80         40.5         81,287         5,620         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,808         131.40           80         42.4         87,500         5,808         131.37           82         44.2         87,746         6,406         131.50         270           82         45.5         97,037         6,564         131.50         320           83         53.1         119.760         8,224         131.30         340           84         48.1         104,824         7,128         131.30         340           85         56.1         128,843         8,892         131.30         340           86         57.8         134	7-Jan-93 150			24,956	1,646		131.56		022.5		100	463		25	3.8			6	5	4,140
69         27.5         44,745         2,996         131.30           69         27.5         44,745         2,996         131.40           72         33.9         63,681         4,296         131.40           72         33.9         63,681         4,296         131.40           79         38.0         75,658         5,106         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,908         131.40           42.4         42.5         89,034         6,012         250           44.2         44.7         84.746         6,406         131.50         270           82         44.7         94.746         6,406         131.50         320           80         48.1         104,824         7,128         131.50         320           82         45.5         97,037         6,564         131.30         340           82         56.1         128,843         8,892         131.30         340           86         57.8         134,120         9,292         131.30         350           86         57.8         134				34,914	2,322		131.56		5,220	+	1/34	200	21.	2 4 6	0 6		1	6	96	4.140
69         27.5         3.736         131.40           72         33.9         63,681         4,296         131.40           72         36.6         13.287         5,106         131.40           80         40.5         83,287         5,620         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,908         131.30           42.4         42.5         89,034         6,012         250           82         44.7         84,746         6,406         131.50         270           82         45.5         97,037         6,564         131.50         320           83         53.1         119.760         8,224         131.30         340           83         53.1         119.760         8,224         131.30         340           84         56.1         134,120         9,292         131.30         350           85         56.1         131.30         350         350           86         57.9         134,120         9,292         131.30         350           86         57.9         134,20         9,292 <td></td> <td></td> <td></td> <td>44,745</td> <td>2,996</td> <td></td> <td>131.30</td> <td></td> <td>5,220</td> <td>1</td> <td>1/45</td> <td>2</td> <td>2</td> <td>2</td> <td>,</td> <td></td> <td>1</td> <td>-</td> <td></td> <td></td>				44,745	2,996		131.30		5,220	1	1/45	2	2	2	,		1	-		
73         31.2         55,429         3,736         131.40           72         33.9         63,681         4,296         131.40           36.6         36.6         5,106         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,908         131.40           80         42.0         87,500         5,908         131.37           42.4         42.5         89,034         6,012         250           43.2         44.2         84.746         6,406         131.50         320           80         44.7         84.746         6,406         131.50         320           80         48.1         104,824         7,128         131.50         320           80         48.1         104,824         7,128         131.30         340           81         55.1         128,843         8,824         131.30         340           82         56.1         128,843         8,224         131.30         350           86         57.9         134,120         9,292         131.30         350           89         59.5         13												19	1	36		40		6	2	4.137
72         33.8         63,681         4,296         131.40           36.6         56.6         5,106         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,808         131.37           42.4         87,500         5,808         131.37           43.2         44.2         89,034         6,012         250           44.2         87,746         6,406         131.50         270           82         44.7         84,746         6,564         131.50         320           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,224         131.30         340           84         56.1         128,843         8,922         131.30         350           85         56.1         128,843         8,292         131.30         350           86         57.9         134,120         9,292         131.30         350           86         57.9         134,120         9,292         131.30         350	a. lan. 93 011				3,736		131.40		5,218		1752	103	7	2 2			2	-		4 134
78         36.6         5,106         131.40           80         40.5         83,287         5,620         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,808         131.37           42.5         89,034         6,012         250           43.2         44.2         84,746         6,406         131.50           82         44.7         84,746         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,224         131.30         340           86         57.9         134,120         9,292         131.30         350           86         57.9         134,120         9,292         131.30         350           59.5         138,920         35.0         35.0         36.0	8. lan-93 0400			1	4,296		131.40		5,219	1	1752	162		67	-		1			
78         36.6         5,106         131.40           80         40.5         83,287         5,620         131.40           80         40.5         83,287         5,620         131.37           80         42.6         87,500         5,808         131.37           42.6         89,034         6,012         250           43.2         44.2         84,746         6,406         131.50           82         44.7         84,746         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,224         131.30         340           84         56.1         128,843         8,922         131.30         340           85         56.1         128,843         8,922         131.30         350           86         57.9         134,120         9,292         131.30         350           86         57.9         134,120         9,292         131.30         350	8. Jan. 93 064	1		1								1	1	+	-					
78         38.0         75,658         5,106         131.40           80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,808         131.37           42.4         89,034         6,012         250           43.2         44.2         6,012         250           82         44.7         84,746         6,406         131.50         270           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,24         131.30         340           84         56.1         128,843         8,922         131.30         340           85         56.1         128,843         8,922         131.30         350           86         57.9         134,120         9,292         131.30         350           58.3         56.5         131.30         350         360	A- Jan-93 070	5	36.6							1		3		36		88	T.	6	16	4.132
80         40.5         83,287         5,620         131.40           80         42.0         87,500         5,908         131.37           42.4         42.5         89,034         6,012         250           43.2         44.2         84,746         6,406         131.50           82         44.7         84,746         6,564         131.50           80         48.1         104,824         7,128         131.50           83         53.1         119,760         8,24         131.30         320           84         56.1         128,843         8,922         131.30         340           85         56.1         128,843         8,922         131.30         350           86         57.9         134,120         9,292         131.30         350           58.3         56.5         131.30         350         360	8-Jan-93 082				5,106		131.40		5,208		1/43	100	y (	2 2 2	4 3		K	6	92	4.131
80         42.0         87,500         5,908         131.37           42.4         89,034         6,012         250           43.2         44.2         250         250           44.2         44.2         250         250           82         44.7         34,746         6,406         131.50           80         48.1         104,824         7,128         131.50         320           80         48.1         104,824         7,128         131.50         320           81         53.1         119,760         8,224         131.30         340           82         56.1         128,843         8,992         131.30         340           86         57.9         134,120         9,292         131.30         350           58.3         56.5         131.30         350         360	8. Jan-93 110				5,620		131.40		5,210		06/1	200	1	3 6			1_	6	06	4.130
42.4         89,034         6,012         250           43.2         43.2         250         250           43.2         44.7         34,746         6,406         131.50         270           82         44.7         84,746         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,224         131.30         340           84         56.1         128,843         8,892         131.30         340           86         57.9         134,120         9,292         131.30         350           58.3         56.5         138,920         131.30         350	8-Jan-93 1220				5,908		131.37		5,210		1/46	=		2				-		
42.5         89,034         6,012         250           43.2         44.2         24.2         250           44.2         44.7         34,746         6,406         131.50           82         44.7         94,746         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           83         53.1         119,760         8,224         131.30         330           86         57.9         134,120         9,292         131.30         350           58.3         56.1         128,843         8,992         131.30         350           59.5         138,920         131.30         350         360	8-Jan-93 124	2	42.4							102	Social potalisminos had son	and potential		100	oums mounting flance	18 + OV8	board flo	+ overboard flow through	h sensor	
43.2         44.2           44.2         44.7           82         44.7         94,746         6,406         131.50           80         48.1         104,824         7,128         131.50         270           83         53.1         119,760         8,224         131.30         330           82         56.1         128,843         8,992         131.30         340           86         57.9         134,120         9,292         131.30         350           59.5         138,920         131.30         350	8-Jan-93 125	0	42.5	- 1	6,012			250	100-200 mi or	O mi or sout nad	So mad accur	- 10			-			_	_	
82         44.7         94,746         6,406         131.50           82         45.5         97,037         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           49.5         49.5         119,760         8,224         131.30         330           82         56.1         128,843         8,992         131.30         340           86         57.9         134,120         9,292         131.30         350           59.5         138,920         350         360         360	8-Jan-93 144	2	43.2						WILCI	approx.	Joseph Park	etartod,	ctart	of Stage II	=					
82 44.7 94,746 6,406 13150 270 82 45.5 97,037 6,564 131.50 270 80 48.1 104,924 7,128 131.50 320 49.5 53.1 119,760 8,224 131.30 340 86 57.9 134,120 9,292 131.30 350 59.5 138,920 57.0 131.30 350	8-Jan-93 154	5	44.2		- 1				Seal 188	Kage colle	Seal leakage collection in bearer stated	16.1		26	7	177	9 2	6	94	4,111
82         45.5         97,037         6,564         131.50         270           80         48.1         104,824         7,128         131.50         320           49.5         49.5         1119,760         8,224         131.30         330           82         56.1         128,843         6,892         131.30         340           86         57.9         134,120         9,292         131.30         350           58.3         59.5         138,920         131.30         350	8-Jan-93 161				- 1		131.50		5,213		1730	160		25	4.0			6	9.2	4,106
80         48.1         104,924         7,128         131,50         320           83         53.1         119,760         8,224         131,30         340           82         56.1         128,843         8,892         131,30         340           86         57.9         134,120         9,292         131,30         350           59.3         138,920         131,30         350	B. Jan-93 1700			1	6,564		131.50	0/2	0,210	1	900	-		24	6		9	6	9.1	4,102
83         53.1         119.760         8,224         131.30         330           82         56.1         128,843         8,892         131.30         340           86         57.9         134,120         9,292         131.30         350           58.3         58.3         138,920         360         360	8. Jan-93 193		48.1		7,128		131.50	320	5,218		1/08			-						
83         53.1         119,760         8,224         131,30         330           82         56.1         128,843         6,892         131,30         340           86         57.9         134,120         9,292         131,30         350           59.3         59.3         138,920         360         360	8-Jan-93 2100								1	1	1757	183		26	4	0 75	7 7	6	94	4,108
82         56.1 128,843         6,892         131.30         340           86         57.9 134,120         9,292         131.30         350           59.3         59.3         138,920         360         360	0. Ian.93 004		53.1		8,224		131.30	330			10/1	213	,	2 2	-		1	0	6.0	4 104
86 57.9 134,120 9,292 131.30 350 59.3 59.5 138,920	0 Jan-93 033	L	56.1		8,892		131.30	340			1733			200	2 6				8.9	4 106
59.5 138,920	o. 1ap. 93 052	L		134,120	9,292		131.30	350	5,218	1	1710	661		4.7	1			1		
59.5 138,920	9-Jan-93 055		58.3									+	1	+	-					
096	200000000000000000000000000000000000000		59.5	138 920						1		-	1	+				1	100	4 405
84 60 0 140 419 9.768	9-Jan-95 070	L	0 09	140 419	9,768		131.20	360	5,215		1709	159	6	22	2 .0		1	360	3 6	4 107
131 20 370	9-Jan-83 012				10 016		131 20	370	5,215		1721	160		25	25 3.7 78 8 8 3.3 4.10	1/8	9	2	5	4,1071

Static Reading (Offset): During Stage 1 & Stage II = 3.0 pst.; Before Stage III = 2.6 pst.; After
 Static Reading (Offset) During the Whole Test = -7.0 pst.
 Static Reading (Offset) During the Whole Test = -4.0 pst.

	NS .	S/N: MX	MX 490659B	_			د ۶	PUMP TE	ST DATA WPAFE	FOR AIR PUMP 1	PUMP TEST DATA FOR ARICRAFT HYDRAULIC FLUID WLAMLBT, WPAFB PUMP TEST STAND NO. 1	DPRAULIC VD NO. 1	FLUID			Mil- H-5606F MLO 92-144
- Thro	A. Throttling Valve Open B. Throttling Valve Closed	Open														
	Coolant			Flow	Flow Rate			1	8	ature (F)	1		colant Te		(F)	
Test Hrs.	Flow (GPM)	Ž	Main	(GPM) Case	(M) e	Disk	Foler Per Per	-	Pump	Case Drain	Outlet	1801	Heat Exchanger Inlet	Heat Exchanger Outlet	changer	REMARKS
	A B	<	8	<	60	<b>6</b> 0	<	<b>~</b>	- 60	88	& <	<	8	۷	8	
120		-		Т	2.0 hours	0 0	) for test	stand re	finemen							Stage 1 - Test Start.
12.2					-	_		_								Sample Taken (Stage I - 0.2 hrs.)
14.7		_			_											Manual Shutdown.
14.7																
14.9																Auto Shutdown @ 14.9 hrs., cause unknown. Test Restart.
16.3		50.27		3.30			180	189		222	209	83		104		
18.0								-		-						Sample Taken (Stage 1 · 6 hrs.)
19.0		50.30		3.40			180	186		222	509	83		20		
21.0		50.30		3.40			178	187		220	208	84		104		
24.3		49.60		3.40	_		179	188		220	208	8.7	7	107		
27.5	-	49.90		3.40			178	187		219	207	86	5	107		
27.5																Sample Taken (Stage I - 15.5 hrs.)
31.2		50.20		3.50			179	188		220	509	89		109		
33.8		50.20		3.50			179	189		220	209	89	6	110		
36.6								-								Manual Shutdown @ 36.6 - Computer problem.
36.6								-								Test Restart
38.0		49.90		3.30			178	187		219	207	87	7	108		
40.5		50.10		3.40			178	187		219	207	88	6	109		
42.0		50.10		3.40			177	187		219	207	87	7	108		
45.4								+		1						Sample Taken (Stage I - 30 hrs.)
42.5																Test stopped for inspection after stage I
43.2								-								Stage II . Test Start
44.2								-	٦	1						Sample Taken (Stage II - 1 hr.)
44.7		50.20		3.50			205	21.		244	234	122	2	144		
45.5		49.70		3.50			211	220		249	239	130	0	150		
48.1		49.60		3.60			214	223		252	242	136	9	155		
49.5																Sample Taken (Stage II - 6.3 hrs.)
53.1		51.20		3.80			207	216		246	236	127	7	147		
56.1		50.10		3.80			211	221		249	239	134		153		
57.9		49.42		3.80			211	220		249	240	134		154		
58.3		_														Sample Taken (Stage II - 15.1 hrs.)
59.5		-														Broken wire repaired - Main flow update
0.09		49.45		3.80			208	219		248	238	134	_	153		

TEST PUMP : MODEL S/N :	MODEL. S/N:	MODEL Vicker S/N: MX 490659B	Vickers PV3-300-7B 0659B	/3-300-7B			-	PUMP TEST DATA FOR ARCRAFT HYDRAULIC FLUID	DATAFO	RAIRCRA	FT HYDRAI	ULERWE	_		TEST	TEST FLUID:	MII-H-5606F	306F				
A- Throttling Valve Open	o Valve	Open					-	WLMLBI, WPAPB PUMP IESI SIAND NO.	VFAFB PL	JMP IEST	SI AND IN	- <u>-</u>					MLO 82-144	*				
B- Throttling Valve Closed	9 Valve	Closec	_																}			
		Test		•	Total Flow			Total	Spe	p	Torque	ent	Motor			Pressure Drop (PSI	p (PSI)		T	Pump Inlet	Pum	Pump Outlet
		3	Test		(Gallons)		Resrv.	Sea	(RPM)	₹	(jqj-uj)	č	Current	_	Main	Case	Case Filter	Cass		Pressure	Pre	Pressure
Date	Time	Temp.	Ŧ.				Fluid	Leakage					(amps)	+	Filter 1	Pall Corp.	Sorp.	Filler	-	(bsig)	٩	(psig)
		Œ	(as on the	Main	3	2	Level	(E)						:				:		_		
			counter)				(mm)		<	8	<		<	۷ 8	8	ΦD	ပ စီ	<	<u> </u>		<	8
29-Jan-93 1302	1302	98		65.5 157,108	11,028		131.07	415	5,215		1746		161	۲۷	9,	3.6	7	7		0.6	4,102	
29-Jan-93 1812	1812	81		70.7 172,598	12,196		130.90	4 80	5,215		1727		161	7	25	3.3		7		96	4,109	
29-Jan-93 2016	2016	9	72.8	72.8 178,797	12,674		130.90	500	5,212		1726		161	۲۷	24	3.2	75	7		9.0	4,104	
29-Jan-93 2040	2040		73.2										1	4					-			
29-Jan-93 2042	2042		73.2	73.2 179,997	12,768								-	_	$\frac{1}{1}$			1	-	+		
17-Feb-93 0905	0905		76.4																-			
17-Feb-93 0917	0917		9.92										+	+	_				+	+		
17-Feb-93 0930	0830		76.7										-	-					+			
17-Feb-93 1006	1006	83	78.3	78.3 193,369	13,854			200	5,230		1734		163	2	23	2.8	85	7	$\dashv$	94	4,078	
17-Feb-93	1145	85		78.9 195,333	14,028			500	5,230		1731		163	2	23	2.7	98	8		9.1	4,072	
17-Feb-93 1430	1430	8.7	81.6	81.6 203,566	14,762			200	5,240		1721		161	2	22	2.4	88	8	+	93	4,071	
17-Feb-93 1536	1536		82.7																-			
17-Feb-93 1710	1710	88		84.3 211,643	15,490			200	5,240		1729		161	7	23	2.0			+	93	4.070	
17-Feb-93 2015	2015	9.1	89.4	89.4 227,216	16,906				5,245		1743		162	2	23	1.4	92	8	-	93	4,070	
18-Feb-93 0015	0015		91.4										+	+	-				+			
18-Feb-93 0500	0200	603		96.2 247,478	18,760			200	5,245		1745		162	-	23	0.7			+	9.5	4,069	
18-Feb-93 0805	0805	90		99.2 256,652	19,620				5,240		1728		160	-	23	0.3	9.8		+	9.1	4,065	
18-Feb-93 1422	1422	91	ı	105.6 275,677	21,424				5,240		1725		160	۱۳	22	-0.1	98	8	-	94	4,064	
18-Feb-93 1445	1445		106.0	106.0 276,964	21,544								+	-					-	-		
19-Feb-93 0900	0060		106.0										-	$\dashv$					-	-		
								• ;	Static Res Static Res	ading (Office)	• Static Reading (Offset) : During Stage I & Stage II = 3.0 psi.; Before Stage III = 2.6 psi.; After Stage III = 0.1 psi •• Static Reading (Offset) During the Whole Test = •7.0 psi.	ng Stage I g the Who	& Stage	a II = 3.	0 psi.; B osi.	efore Sta	9e = 5	.6 psi.; /	After St	=    e6#	0.1 psi.	
								•	Static Rea	ading (Off	*** Static Reading (Offset) During the Whole Test = 4.0 psi	g the Who	le Test	4.0 £	osi.							

TEST FLUID: Mil: H-5606F MLO 92:144				REMARKS					Sample Taken (Stage II - 30 hrs.)	Test Stopped for inspection.	Stage III - Test Started	Sample Taken (Stage III - 0.2 hrs.)	Stage III - Test Restarted after unexplained shutdown.		Pump Bybass⋅B := Case temp. @ filter inlet.		Sample Taken (Stage III - 6 hrs.)			Sample Taken (Stage III - 15 hrs.)				Auto Shutdown.	Test #33 Completed.
			hanger	_	8								0,				0,	,							
		Coolant Temperature (F)	Heat Exchanger	Outlet	<	151	154	156						203	206	208		208	509		211	213	215		
Qin		ant Temp	hanger		8																				
PUMP TEST DATA FOR AIRCRAFT HYDRAULIC FLUID WLANLBT, WPAFB PUMP TEST STAND NO. 1		တ္သ	Heat Exchanger	Inlet	<	131	134	137						183	187	187		187	187		188	191	195		т ритр.
TEST DATA FOR AIPCRAFT HYDRAULIC BT, WPAFB PUMP TEST STAND NO: 1			Λ	Outlet	æ																				Pump case drain after removing pump.
PCRAM TEST		(	Ĺ	0	<	236	237	239	L	L		L		275	284 270 277	277		283 270 276	282 268 275		282 268 276	283 270 276	278		after r
ORAI		uid Temperature (F	Case	Orain	6	9	9	8	L	_		L		-	4 270	283 270	L	3 27(	2 26		2 26	3 27(	2	L	drain
ATA F		peral	-	-	<	246	246	248	L	-	_	L		281	28	28	_	28	28	_	28	28	285	_	case
STD T, WP		d Ten	Pump	Outlet	89	17	8	19	H	-	L	L		7	6	6	L	8	7	L	8	6	19		d mn
PUMP TI		Ē	-		<b>A</b>	21	218	21	-	$\vdash$	-	-		257	259	259	_	25	257	-	258	259	26	-	3
₹ ₹			Pump	Inlet	A	8	6	0	-	L	L	L	L	_	6	0	_	6	6	_	8	6	=	H	it line
		$\vdash$				208	209	210	1	$\vdash$	L	H	-	247	248	250	_	249	249	L	248	249	251	$\vdash$	h. inle
				Disk	8	-			-	L		-	_				_			_			_		leat exc
		ate			8	$\vdash$	-	-	$\vdash$	-		-					-	-	_	-					line, 2)
90-78		Flow Rate	(GPM)	Case	_	000	3.90	3.90		+	-		-	4.40	4.50	4.60		4.60	4.70		4.70	4 80	4.80		Three samples taken: 1)Main return line, 2)Heat exch. inlet line,
Vickers PV3-300-7B MX 490659B				$\vdash$	60	╁		-		$\frac{1}{1}$		H	$\vdash$			-			F	$\mid$	-			-	: 1)Ma
Vickers PV3- MX 490659B	c 9			Main	<	50.65	49.90	49 90	+	+				50.25	50.07	50 12		50.14	50.64		50.60	50 00	50.00		es taker
S.S.	\$ 000 s	=		_	-	Г				T		T	T			-								T	Samp
: WODE	ting Ved	Coolan	Flow	(GPM)	-				$\dagger$			$\dagger$	-									<u> </u>		+	Three
TEST PUMP : MODEL S	A= Throttling Valve Open B= Throttling Valve Closed		Test	H.G.	1	65.5	707	7.2 A	73.5	73.5	76.4	76.6	76.7	78.3	78.9	818	82.7	84.3	89.4	4 10	96 2	000	105.6	1080	106.0

Appendix D

Raw Data for Pump Test 34

with MIL-H-87257

TEST FLUID: PUMP TEST DATA FOR ARCRAFT HYDRAULIC FLUID TEST PUMP : MODEL Vickers PV3-300-7B S/N : MX 490651B

Mil-H-87257 (Royco)

| A.: Throttling Valve Onen               |           |  |  |   |   |   |  
   
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  |             |
| B. Throttling Valve Closed              | 0500      | Total  | Total Close  |   | Total   | Soo   | Pe   
   
  | Torque   
   
  |  
   
  | Motor  | L  | Pres  | Pressure Drop (PSI  | (PSI)  
  |   | Pump  | H   | Pump Inlet  | Pump   
  | Pump Outlet |
| Cel                                     | Cell Test | (Sall  |  | Reary.  | Seal  | (APM)   | -  
   
  | (in-lbf)   
   
  |  
   
  | Current  | Main   | ē   | Case Filter   | ller   
  | Case  |   |   | Pressure  | Pressure   
  | enre        |
| Time Te                                 | _         |  |  | Fluid   | Leakage   |   |  
   
  |  
   
  |  
   
  | (amps)   | Flex   | -   | Pressure (psi)  | (Bal)  
  | Filter  | T   |   | Bigg  | (Disd)   
  | a           |
|   |           | Main   | Care   | Level<br>(mm)   | (m)   | <   | 8  
   
  | <  
   
  | 8  
   
  | 8<br>V   | <b>∇ &lt;</b>  | 8   | inlet   | outlet   
  | < <   | Pressu<br>B (psig   |   | 8   | <  
  | 8           |
| 137                                     | 0         | 0  |  |   |   |   |  
   
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| - ''' '' '' '' '' '' '' ''' '' '' ''' ' |           | (F) (as or response) (as or response) (b) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c | (F) (a tris.) (Counter) (C | (F)         (aunior)         Main         Cate           counter)         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           0.0         0.0         0.0         0.0           1.0         0.0         0.0         0.0           1.0         0.0         0.0         0.0           1.0         0.0         0.0         0.0           1.0         0.0         0.0 | (F)         (aun the counter)         (aun th | (F)         (as on the proper)         (main)         Cause (min)           counter)         0.0         (min)         (min)           0.0         0.1         (min)         (min)           0.2         0.3         (min)         (min)           0.1         0.3         (min)         (min)           0.2         0.1         (min)         (min)           0.3         0.3         1.0         2387         156           75         1.0         2.387         156         1775           78         6.1         1.788         131.75         17.6           78         10.4         304.56         2.094         131.75           78         10.4         304.56         2.094         131.75           78         2.1         614.16         42.36         131.75           76         18.9         550.63         37.99         131.56           76         22.1         614.16         42.36         76           76         22.1         66.92.7         46.18         131.56           76         22.3         66.92.7         46.18         131.56           77         22.0         75741 | (F)         (ae or the oreal counter)         Mein         Case Lavel (mm)           counter)         0.0           0.1         (mm)           0.2         (mm)           0.3         (mm)           0.1         (mm)           0.2         (mm)           0.3         (mm)           0.1         (mm)           0.2         (mm)           0.3         (mm)           1.0         2.3           1.0         2.0           1.1.0         2.0           1.1.0         2.0           1.1.0 <t< td=""><td>(F) (a true)         (am)         Cate         Lave         (m)         A           Counter)         0.1         (mm)         A           0.1         0.1         5236         5230           75         1.0         2387         156         5230           76         3.9         10885         758         131.94         5210           76         3.9         10885         758         131.94         5210           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           76         21.1         61416         4236         5220         5220           76         22.1         66927         4618         131.56         20         5230           77         22.0         72741         5230         5230           77         22.0<!--</td--><td>(F) (a number)         Main         Cate (mm)         A         B           counter)         (mm)         A         B           counter)         (nm)         A         B           0.1         (mm)         A         B           0.3         (mm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.3         (nm)         A         B     <!--</td--><td>  Famp   Fries   Case   Lavel   Fries   Case   Case</td><td>  Fample   Main   Cate   Lavid   (min)   A   B   A   A</td><td>  Fample   Main   Care   Lavia   Time   A   B   A   B    </td><td>  Figure   Figure   Care   Lavel   City   Counter)   Care   Lavel   City   Counter)   Care   Care   City   Care   Care  </td><td>  Fig.   Fig.  </td><td>  Fig.   Fig.  </td><td>  Fig.   Fig.  </td><td>  Fig.   Care to the Main   Care   Law   (mi)   A   B   A   B   A   B   A   B   Inlet   Outlet   A   B   Countent   A   Countent  </td><td>  Fig.   Fig.  </td><td>  Fig.   Care   Main   Cate   Lavie   mit   A   B   A   A</td><td>  Fig.                                      </td></td></td></t<> | (F) (a true)         (am)         Cate         Lave         (m)         A           Counter)         0.1         (mm)         A           0.1         0.1         5236         5230           75         1.0         2387         156         5230           76         3.9         10885         758         131.94         5210           76         3.9         10885         758         131.94         5210           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           78         8.0         26111         1796         131.75         5220           76         21.1         61416         4236         5220         5220           76         22.1         66927         4618         131.56         20         5230           77         22.0         72741         5230         5230           77         22.0 </td <td>(F) (a number)         Main         Cate (mm)         A         B           counter)         (mm)         A         B           counter)         (nm)         A         B           0.1         (mm)         A         B           0.3         (mm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.3         (nm)         A         B     <!--</td--><td>  Famp   Fries   Case   Lavel   Fries   Case   Case</td><td>  Fample   Main   Cate   Lavid   (min)   A   B   A   A</td><td>  Fample   Main   Care   Lavia   Time   A   B   A   B    </td><td>  Figure   Figure   Care   Lavel   City   Counter)   Care   Lavel   City   Counter)   Care   Care   City   Care   Care  </td><td>  Fig.   Fig.  </td><td>  Fig.   Fig.  </td><td>  Fig.   Fig.  </td><td>  Fig.   Care to the Main   Care   Law   (mi)   A   B   A   B   A   B   A   B   Inlet   Outlet   A   B   Countent   A   Countent  </td><td>  Fig.   Fig.  </td><td>  Fig.   Care   Main   Cate   Lavie   mit   A   B   A   A</td><td>  Fig.                                      </td></td> | (F) (a number)         Main         Cate (mm)         A         B           counter)         (mm)         A         B           counter)         (nm)         A         B           0.1         (mm)         A         B           0.3         (mm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.1         (nm)         A         B           0.2         (nm)         A         B           0.3         (nm)         A         B </td <td>  Famp   Fries   Case   Lavel   Fries   Case   Case</td> <td>  Fample   Main   Cate   Lavid   (min)   A   B   A   A</td> <td>  Fample   Main   Care   Lavia   Time   A   B   A   B    </td> <td>  Figure   Figure   Care   Lavel   City   Counter)   Care   Lavel   City   Counter)   Care   Care   City   Care   Care  </td> <td>  Fig.   Fig.  </td> <td>  Fig.   Fig.  </td> <td>  Fig.   Fig.  </td> <td>  Fig.   Care to the Main   Care   Law   (mi)   A   B   A   B   A   B   A   B   Inlet   Outlet   A   B   Countent   A   Countent  </td> <td>  Fig.   Fig.  </td> <td>  Fig.   Care   Main   Cate   Lavie   mit   A   B   A   A</td> <td>  Fig.                                      </td> | Famp   Fries   Case   Lavel   Fries   Case   Case | Fample   Main   Cate   Lavid   (min)   A   B   A   A | Fample   Main   Care   Lavia   Time   A   B   A   B | Figure   Figure   Care   Lavel   City   Counter)   Care   Lavel   City   Counter)   Care   Care   City   Care   Care | Fig.   Fig. | Fig.   Fig. | Fig.   Fig. | Fig.   Care to the Main   Care   Law   (mi)   A   B   A   B   A   B   A   B   Inlet   Outlet   A   B   Countent   A   Countent | Fig.   Fig. | Fig.   Care   Main   Cate   Lavie   mit   A   B   A   A | Fig.        |

Δ Static Reading (Offset) During the Whole Test = -9.0 psi. ΔΔ Static Reading (Offset) During the Whole Test = -6.0 psi.

TEST PUMP : MODEL Vickers PV3-300-7B SN: MX 490651B

PUMP TEST DATA FOR ARCRAFT HYDRAULIC FLUID WLMLBT, WPAFB PUMP TEST STAND NO. 1

Mil- H-87257 (Royco) MLO 92-11, MLO-92-142C TEST FLUID:

A. Throttling Valve Open B. Throttling Valve Closed

B. Thro	B= Throttling Valve Closed	0800									1		ľ				
	Coolant			Flow	Flow Rate		1		Fluid	퇿	E E		ន	Coolant lemperature (F)	perature	E	
Test	Flow			(GF	(GPM)			Pump	Pump	_	Casa	≥	Heat Ex	Heat Exchanger	Heat Ex	Heat Exchanger	
Hrs.	(GPM)	ž	Main	Case	98	Disk	¥	Inlet	Outlet	+	Drain	Outlet	Ē	Inlet	0	Outlet	REMARKS
	€	_	8	<	60	<	60	- W	<	· <		8	<	9	<	8	
0.0	$\vdash$							_	-	_							Stage 1 - Test Start.
0.1																	Sample Taken (Stage I-0.1 hrs.).
0.3																	Manual Shutdown (Cooling water leak).
0.3																	Test Restart.
1.0		49.8		3.6				181	190	219		209	83		124		
3.6																	Auto Shutdown (Reason Unknown).
3.6																	Test Restart.
3.9		49.8		3.5			-	181	181	216		210	83		126		
6.1																	Sample Taken (Stage 1-6.1 hrs.).
9.0		50.0		3.4	-		-	181	190	216		209	83		124		
10.4		50.3		3.4			-	181	190	217		209	84		123		
110																	Auto Shutdown (Operator error while changing warning settings).
11.2										-							Test Restart
12.9		49.9		3.5			Ī	181	180	212		209	84		124		
15.3					T												Sample Taken (Stage 1-15.3 hrs.).
15.9		50.2		3.5		-	Ī	181	190	213		210	84		124		
18.9		49.8		3.5				181	190	212		209	84		124		
21.1		49.7		3.5			_	181	190	212		209	84		123		
22.9		49.7		3.5			-	181	190	212		209	84		124		
23.1																	Manual Shutdown.
23.1					-												Test Restart.
23.3																	Auto Shutdown (Reason Unknown).
23.3							8	Bypass T/C be	0	23.3	irs. Reg	@ 23.3 hrs. Reading from Omega.	Отеда.	(Case filter inlet Temp.)	r inlet Te	mp.)	Test Restart.
25.0		49.7		3.5			-	181	190		218	209	83		124		
26.0		49.8		3.5			-	181	190		216	209	83		123		
27.2		49.7		3.5			-	181	190		218	209	82		124		
28.6		49.8		3.5			_	180	190		218	209	82		124		
30.2		49.6		3.4	-	-	-	179	189		216	208	82		122		
30.3							-										Sample Taken (Stage 1:30.3 hrs.).
30.3																	Manual Shutdown - Stage I Completed - Pump Inspected.
30.3																	Stage II - Test Start.
30.7																	Auto Shutdown (Reason Unknown).
30.7																	Test Restart.
30.8	_									_							Sample Taken (Stage II-30.8 hrs.).
												444					

At pump case outlet.
 At pump case filter inlet (after case flow heat exchanger; before inlet to case filter).

Joort Con to Section	Ş	Viet.	07 000 0V0 modely	97.000													TEST FLUD	QI) L					
S. TOMP : M.		MX 490651B	18					PUMP TE WLAMLBT	ST DATA F	PUMP TEST DATA FOR ARCRAFT HYDRAUUC FLUID WLAILBT, WPAFB PUMP TEST STAND NO. 1	AFT HYDR	AULIC FLI NO. 1	<u>e</u>						Mil·H·87257 (Royco) MLO 92·11, MLO-92·142C	57 (Roy 1, MLO	co) -92-142	ပ္	
A= Throttling Valve Open	Valve (	Open																					
		Test		Total	Total Flow		Total	S	Speed	Torque	ent	Motor	Ц		Pressure Drop (PSI	p (PSI)			-	Pump Intel	tet	Pump Outlet	Suttet
	_			(Gallons)	ons	Rosev.	Seal	(MPM)	3	(in-li	5	Current		Main Eilter 1	Case Filter	Case Filter	Case		Case	Pressure (nsin)	•	Pressure (naio)	2 -
e e	e E	F) (as on	å.	Z E	Case	Level	(ml)						-	-			4	T	Pressure				
			1			(mm)		<	8	<		B V	7	8	Intet	3	_	9	(bsig)	<b>4</b>	<u> </u>	< !	8
14-Apr-93 10	1045			93607	6526	131.75		5218		1730		162	16		93		5	+	95	28		101	
14-Apr-93 14	1404	90	1	03369	7310			5218		1712		159	16		9.5	44	7	+	138	92	+	101	
14-Apr-93 1455	155		36.3									-	-				+	+			+	1	
14-Apr-93 17	1730	83	38.9 1	113726	8134			5217		1725		160	+		96		+	+	*	96	+	4 10	T
14-Apr-93 2055	055		44.3 1	129786	9404	131.56		5215		1746		161	4		94	96	+	+	144	94	1	4160	T
15-Apr-93 00	0000		45.4														+	+			1		T
15-Apr-93 03	0342	82	49.1	144339	10546	131.44	50	5215		1727		160	=		96		+	+	144	95	+	4160	
15-Apr-93 0	0555		51.3 1	150997	11066	131.44	20	5215		1726		160	=		96		0	+	144	96	1	4161	
15-Apr-93 08	0855	08	54.3	159951	11776	131.44	50	5215		1716		160	7		94		9	1	4	94	1	4160	
15-Anr-93 1245	245	180	1	171531	12686	131.44	50	5215		1752		162	17		95	96	0		143	95	1	4157	
15 Apr. 03 1/	1448		1	177564	13162		50	5217		1726		160	17		94	96			140	94	7	4159	
CG 100-C	2 :											_								_	_		
13. Apr. 83	200	+	200	Ī									_				$\vdash$	_		-			
13-Apr-83	000	1	200									-	L				-				-		
26-Apr-83 1355		1	200	T														-					
26-Apr-93 1	2	+	7 60	T									-					-					
26-Apr-93 1	25.		200														T				-		
26-Apr-93 1435	435	1		7000	19690	T		5230		1721		162	14		92	93	-	-		93	-	4127	T
26-Apr-93 1530	230	60	1	100	13366													-			-		
26-Apr-93 1720	720	1	1_	0000	14484	00 000	0.9	6230		1708		159	14		92	93	0	-		9.1	Ť	4119	
26-Apr-93 1825	825	98	- 1	130030	46796		2	3530				3	-					-			$\vdash$		
26-Apr-93 1	1930	+	200	T	13/30							-	-	I				-					
26-Apr-93 2025	025	1		02.000	00200	0,00,	7.0	6000		1704		150	1		92		-	-		9.2		4119	
26-Apr-93 2	2125			00000	10/00		1,5	5000		1710		160	1.5		9.6	86		$\mid$		9.7		4124	
26-Apr-93 2	2310	E	2 0 0 0	204935	8/1/1		2	25.30				2	-				L	-				-	Ī
27-Apr-93 0018	0 0	+	0.0										-										
27-Apr-83 U	0040	-				Manual Churt	Shuldown	/Ehild o	verflow th	(Fluid overflow through relief valve in high pressure line)	f valva in	hich pres	sura line										
27-Apr-93 U	200	1	0									_	L					-					
28-Apr-93 0638	929	+									Ī							-			-		
28-Apr-93 0702	702		73.0									1	-	I			<b>†</b>	+	Ì	$\dagger$	1		
28-Apr-93 0704	704		72.0									+	+	Ţ			$\dagger$	+	T	$\dagger$	$\dagger$	$\dagger$	
28-Apr-93 0823	823	-	73.3									-	1	$\prod$			$\dagger$	+	1		$\dagger$		
28-Apr-93 1	1013		73.3										ı						1				T
28-Apr-93				est stopp	Test stopped & restarted several tim	arted seve	aral times.	Inlet & o	outlet 1/C	outlet 1/C flucuating (opening &	Builde	Closing).		0×0	BSSIVB VI	I hought excessive vibrations may be	2 - 22 -	me cause.		See next page	e abad	Same IIIne)	
	5560		74.8										1				$\dagger$	+		+	+	$\dagger$	
30-Apr-93 1006	900		75.0									+	$\downarrow$	$\int$		I	†	+	$\dagger$	$\dagger$	$\dagger$	$\dagger$	T
30-Apr-93 1012	012									1		-	Ĭ;	$\prod_{i=1}^{n}$	3		1	$\frac{1}{1}$	†	000	Ť	7436	
30-Apr-93 1055	055	87	75.7 2	221105	18574			5230		1712		163	14		9.5	84	5	-		36	1	1071	7
								A Sta	the Readin	Static Reading (Offset) During the Whole Test	During the	Whole	S- = 186	-9.0 DSI									

A Static Reading (Offset) During the Whole Test = -9.0 psl.

A Static Reading (Offset) During the Whole Test = -6.0 psl.

TEST PUMP : MODEL Vickers PV3-300-7B SAN: MX 490651B

PUMP TEST DATA FOR ARCRAFT HYDRAULIC FLUID WL/MLBT, WPAFB PUMP TEST STAND NO. 1

Mil- H-87257 (Royco) MLO 92-11, MLO-92-142C TEST FLUID:

A- Thro	A. Throttling Valve Open	Open								:			5	2		- S		
	Coolant				Flow Rate	-			FEB		Temperature (F)	70 (F)		-	Coolant	Coolant Temperature (F)	ure (F)	
Test	Flow			. ~	(GPM)			Pump	$\vdash$		ပြီ	Case	2	-	Heat Exchanger	-	Heat Exchanger	
Hrs.	(GPM)	2	Main	٦	Case	۵	Disk	Inlet	-	Outlet	_	Orain	Outlet	7	Inlet		Outlet	REMARKS
	4	•	•	•	•	•	α	~	•	•	. <	: =	<			_		
23.4	+			-	L			1	_	+	248		-	-	36	-	99	
35.4	-	49.5	1 15	4 0				209	221	-	247		239	-	134		165	
36.3									-	-				-				Sample Taken (Stage II:36.3 hrs.).
38.9		49.9		4.0				212	22	4	250		242		139		169	
44.3		50.5	15	4.0	0			210	222	2	248		240		134	_	167	
45.4	-	L							H				-					Sample Taken (Stage II-45.4 hrs.).
49.1	-	49.9		4.0	6			212	224	7	250		242		139	-	170	
513		49.9		4.0	_			212	224	4	249		242	_	138		170	
54.3		49.6		4.0	_			212	224	4	249		242		139	•	170	
58.2	_	50.8		4.0	6			213	225	2	250		243		139	-	171	
60.2		49.9		4.0		L		211	223	6	248		241		137	-	170	
60.3									$\vdash$	L	Ĺ							Sample Taken (Stage II-60.3 hrs.).
603		-							-	-							,	Manual Shutdown - Stage II Completed - Pump Inspected.
60 4		-							-	_			-	-				Stage III - Test Start.
60.7		-							-	L				L				Auto Shutdown (Reason Unknown).
60 7	-		L						-	L				-				Test Restart.
6.09		-							-									Sample Taken (Stage III-60.9 hrs.).
61.8		49.9		4.6	25			248	259	6.5	282		276		195	2	220	
63.6		_																Bypass flow indication inoperative.
64.7	-	49.8	6	inop				253	264	4	287	271	281		203	2	227	
62.9	-								$\vdash$					Н				Bypass flow indication operative.
66.7									$\sqcup$							-		Sample Taken (Stage III-66.7 hrs.).
67.7		49.7		4.5	5			253	264	4	287	271	281	$\dashv$	203	7	227	
69.5		49.9	6	4.5	25			252	264	4	286	286 271	280		202	2	226	
70.8																_		Auto Shutdown (Reason Unknown).
70.8									_					_				Test Restart.
71.5				Man	ual Shu	Idown (	Fluid ove	Manual Shutdown (Fluid overflow through	rough	_	valve	n high	pressu	elief valve in high pressure line)	١			
71.6									Н							4		Test Restart.
72.0									_									Auto Shutdown (Reason Unknown).
72.0									Н									Test Restart.
73.3									$\dashv$					-				Manuel Shutdown (Bad pump inlet temperature T/C).
73.3									Н					-				Test Restart.
	0	Opened pump for inspection. Looks good.	mp for	inspect	on. Loc	oks goor		Fixed both T/C leads	C lea	ds.								
74.8														-		4		Test Restart.
75.0									4	4	$\prod$		+	$\dashv$	$\frac{1}{1}$	+	1	Auto Shutdown (Reason Unknown).
75.0		_							$\dashv$				+	$\dashv$	-	-		Test Restart.
75.7	-	49.7		4.6	15			249	255	2	282	282 266 276	276		196	2	221	

. At pump case filter faller case flow heat exchanger; before inlet to case filter).

100	150	Mistor	Mistage DVP 900 7D	3.70													TEST PLUID:	Ö				
TEST PUMP : MOUEL	. K.	MOUEL VICKER	1 1 4 2-20	9/-				PLIMP TE	STDATA	PLANE TEST DATA FOR A PICRAFT HYDRAULIC FLUID	WETHYDE	WULCE	am						Mil-H-87257 (Royco)	oyco)		
ð	Z	TICONAL V						WAMLBT	, WPAFB	WLAMLBT, WPAFB PUMP TEST STAND NO.	STSTAND	NO.						MLO 92	MLO 92-11, MLO-92-142C	0-92-14	2C	
A. Throttling Valve Open	Valve C	hed																				
B. Throttling Valve Closed	Valve C	peso			-		,			1		200	1	9	Droceius Den (DC)	nod) a		Prima	Pumn Inlat	Inlat	Pump Outlet	Aiffet
	_	105	_	NOT EIO	_	-	0.00	de	paadc	2	ordine	505	_		TO OTHER	2 2 2		T	_			-
-	ن	Coll	_	(Gallons)		Resr.	Seal	(HPM)	₹	(jql-uj)	e e	Current	_	Main	Casa	Case Filter	Cass		Pressure	on.	Pressure	2
-	Time Temp	_		-		Fluid	Leaksoe					(amps)		Filter 1	Pressure (psi)	re (psi)	Filter	o original	(bsid)	ā	(PSig)	
		-	the Main		3	Level	Ê						۷۷	8			٧	Pressure				
	-	Countary		_		(mm)		<	89	<	8	<	BA	8	Inlet	outlet	Α 8	(bsig)	<	8	<	<b>a</b>
20. Apr. 93 1330	330	87	4	228822 1	19252 133.10	33.10	90	5230		1714		160		15	88	90	0		90		4119	
30. Apr. 93 1400	000												_								-	
30 Apr. 03 1718	710	A B	82 1 240198	1	20238 133.00	33.00	06	5230		1715		160	_	7	96	97	0		96		4124	
20.40.00			85 8 251377	1	21202 133.00	33.00	100	5230		1715		160	_	5	96	9.7	0		9.7		4122	
30. Apr. 93 £ 100	22.2		87.3 256039		21600 133.00	33.00	105	1		1720		161		14	9.7	92	0		9.7		4122	
1 May 02 0137	127		90.4 265405	1	22396 132.94	32.94	110	5230		1737		162	-	1.5	9.7	98	0		97		4123	
1-May-93 0437	137		93.4 274524		23170 132.88	32.88	115	5230		1700		160		14	96	97	0	146	96 9		4121	
1-May-93 0500	200		93.8	L									$\frac{1}{1}$	-			1				+	
1-May-93 0506	506	٥	93.9 275877	ш	23286								-	4							1	
								A Stat	ilc Readir ic Readir	Static Reading (Offset) During the Whole Test = -9.0 ps. Static Reading (Offset) During the Whole Test = -6.0 ps.	During the During the	• Whole	Test =	9.0 psi 6.0 psi								

TEST PUMP: MODEL	MP:W	ODEL ODEL	Vicke	Vickers PV3-300-7B	1-300-7	<b>6</b>														TEST FLUID:	_
		SAN		MX 490651B	m							<b>3</b> ×	P TEST	T DAT	A FOR	AIRCRAI IP TEST	PUMP TEST DATA FOR ARCRAFT HYDRAULIC FLUID WLMLBT, WPAFB PUMP TEST STAND NO. 1	ULIC FLUIK D. 1	0	Mil: H:87257 (Royco) MLO 92-11, MLO-92-142C	-
₹	cottling	Valve O	5																		
B. 19	Bullio.	Valve Cl	peso																		_
	රි	Coolant			R	Flow Rate	2		H		Fluid	Тетр	Fluid Temperature (F)	Ē		L	Coolant	Coolant Temperature (F)	ure (F)		_
Test	ű.	Flow			<u>ب</u>	(GPM)			4	Pump	Pu	Pump	Case	9	7	-	Heat Exchanger   Heat Exchanger	19r Hea	t Exchang	- T	_
H.		(Md	Mein	ë	S	Case	_	Disk	=	Inlet	ð	Outlet	Drain	ء	Outlet	=	Inlet		Outlet	REMARKS	
						_	L	L		L				:	-	L	_	_			
	<	8	<	8	<	8		Α Β	۷	8	<	8	<	8	B ¥		A B	_	60		_
78.3			50.0		4.4				251	_	257		284	284 270 278	82.		202	2	227		_
78.8	_														_				_	Sample Taken (Stage III-78.8 hrs.).	_
82.1			50.2		4.4				251	-	257		285	285 270 279	179	,,	200	2	224		
85.8	-		50.2		4.4	_			253	3	259		286 2	286 271 281	181	."	202	2	226		-
87.3			50.3		4.4	_			251	_	257		285 270 279	2 07 2	1.0	2	200	2	224		_
90.4			50.8		4.4				253	3	258		286 271 280	271 2	08	5	202	2	226		
93.4			49.7		4.4				251	Ļ	257		285 270 279	2 07	62	2	200	2	224		-
93.8								Ц	Ц	Ц					Н					Sample Taken (Stage III-93.8 hrs.).	_
93.9									_						$\dashv$					Manual Shutdown - Stage III Completed - Pump Inspected.	_
															:						

At pump case outlet.
 At pump case filter inlet (after case flow heat exchanger; before inlet to case filter).